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This three volume set lists in a concise manner the thermodynamic data in condensed media obtained by shock wave techniques. Both dynamic variables and volumetric quantities associated with the shock wave are given. The format was selected to make the volume useful in engineering as well as scientific research activities. Volume 1-Rev. 1 consists of a general introduction and Section A1 which lists shock wave data for Elements. The entire set should be useful to people working either in the shock wave field or in the area of thermodynamic properties at high pressure.

UCRL-50108 Vol. 1 Rev. 1

COMPENDIUM OF SHOCK WAVE DATA

INTRODUCTION AND SECTION A1

M. van Thiel

June 1977

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UCRL-50108 Vol. 1 Rev. 1

COMPENDIUM OF SHOCK WAVE DATA

Introduction
Section A1-Elements

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Notice

The completeness of this compilation depends upon its users. To assure its continued usefulness, users are urged to send any missing or new shock wave data and corrections to the Editor, M. van Thiel, Lawrence Livermore Laboratory, P.O. Box 808, Livermore, California, U.S.A., 94550.

New and revised pages will be distributed as necessary.

Contents

COMPENDIUM OF SHOCK WAVE DATA

Introduction

Abstract

The purpose of this volume is to list in a concise manner the thermodynamic data in condensed media obtained by shock wave techniques. The volume should be useful both to people working in the shock wave field and to others interested primarily in thermodynamic properties at high pressure. Therefore, both dynamic variables and volumetric quantities associated with the shock wave are given. The format has been selected to make the volume useful in engineering as well as scientific research activities.

Content

Tabular Data — The information tabulated is generally derived from shock compression of a sample of known density. Any two of the measurable quantities tabulated (pressure, volume or density, free-surface and particle velocity behind the shock front, as well as shock velocity) may be used to derive the others. Shock and free-surface velocities were measured in most of the experiments performed to date. A description of the basic assumptions and techniques has been given by Rice et al.[1] Some useful texts also exist for those interested in the experimental techniques[2] and for those more theoretically inclined.[2-4]

Pressure (P), volume (V), and energy (E) are usually obtained from the shock (U_s) and particle velocity (U_p) by application of the conservation conditions of mass momentum and energy across a well-defined shock wave. It is, therefore, assumed that steady state exists in front and behind this wave. The conditions are schematically presented in Fig. 1. The distance between the two (cross-hatched) steady-state regions is usually small compared to the dimensions of the system. Conservation of mass and momentum then yields:

$$P_1 - P_0 = \left(U_{s_1} - U_{p_0}\right)\left(U_{p_1} - U_{p_0}\right)/V_0$$

and

$$V_1/V_0 = 1 - \frac{U_{p_1} - U_{p_0}}{U_{s_1} - U_{p_0}} \ ,$$

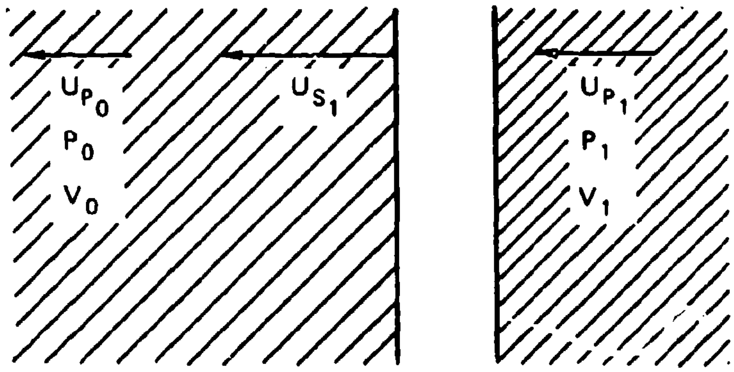


Fig. 1. Shock wave conditions.

while the energy conservation condition is:

$$E_1 - E_0 = (1/2)\ (P_0 + P_1)\ (V_0 - V_1).$$

In the usual single wave experiment, the initial particle velocity, U_{P_0}, is zero. Frequently multiple waves are considered in this compilation. The more general form of the above equations for multiple wave systems is obtained by replacing the subscript 0 by i and 1 by i + 1.

Whenever they are obtainable from shock wave measurements, other directly measured derivatives, such as heat capacity and expansion coefficient, are also listed. However, there is no developed technology for these measurements at the time of this writing.

A convenient summary of the tabulated data may be given in terms of a functional relation between shock (U_s) and particle velocity (U_p) since a valuable feature of dynamic (shock wave) measurements is the slow, and in many cases, vanishing curvature of plots of U_s vs U_p. Least-square fits have been given in this plane whenever the data warrant it:

$$U_s = C + \sum_{i=1}^{n} S_i\ U_p^i\ .$$

The sum is limited to $n_{max} = 1$ for most solids. This Hugoniot equation may be transformed to the pressure-volume plane by use of conservation of mass and momentum equations.

With each set of data from a particular source, the properties that define the initial condition of the sample before shock compression are listed if available. These are:

- V_0: Initial volume.
- V_{0i}: Volume from crystallographic or accurate volumetric techniques (useful for porous materials).
- T_0: Initial temperature.
- Composition.
- C_ℓ, C_s, and C_b or C_0: Respective longitudinal sound velocity, transverse (or shear) wave velocity, and "bulk sound velocity" $[\equiv(\partial P/\partial\rho)_S^{1/2}$ km/sec] derived from static compression or for an isotropic sample $(C_L^2 - 4/3\ C_s^2)^{1/2}$.

The quantity C_0 is helpful in allowing interpolations of the bulk compressibility between the lower limit of the dynamic range and the compressibility at one atmosphere.

It may be noted that no subscripts have been printed in the body of the compendium. This is due to the limited character list of the automatic printer that produced these pages. Therefore, V_0 is written as VO, C_ℓ' as CL, etc.

While the above characterization is adequate for most purposes, some structural transformations are comparable to or slower than the measuring time in shock experiments. Under these conditions, other sample specifications are needed to adequately describe the sample. This problem has come up in detailed investigations of dynamic yield points and in the study of phase transitions and chemical reactions. In the former case, for example, impurity concentration and thermal history become highly important. Mixtures of solids and liquids exhibit relaxation times that depend in a complex fashion on microscopic structure and strength and, for high pressure shocks, on the temperature distribution behind the front.

Comments — A comments section is provided for further characterizations of the material and the experiment. The first comment is reserved for a source statement. This may be the name of a person and an address or journal reference. The second comment contains a characterization of the experimental method and the technique of data analysis. To avoid lengthy descriptions on each data page, short descriptions of each method are given in the section on techniques. These descriptions, of course, do not dwell on details of experimental setup or data handling but are primarily an attempt to give a short and unambiguous classification of a series of data recording and analysis methods. For more detail, the user is referred to papers and books on the subject. A review has been given by Duval and Fowles.[2]

Any number of comments may be listed by the compiler or suggested by the investigator. The extent and format of these comments are flexible and depend on relatively arbitrary decisions of the compiler. It is clear that these comments can never replace the full publication.

Filing Order

The filing order chosen for this volume is independent of arbitrary nomenclature and trade names and, when understood, is equally useful to any language group. However, for those users preferring the English language as a basis for searching this volume, an index for each section is provided. The author index for each section is a convenient guide to the contributors.

The filing order is based on the periodic table. The basic system is described in detail by the Office of Critical Tables,[5] and some modifications have been made in accordance with the latest modification of a numerical order of the elements proposed by Rossini.[6] (See Table 1 and Fig. 4 at the end of the techniques listings.) With some small exceptions, the categories, too, are essentially those given by Rossini. They are:

A_1. Elements: Filed by order number. For example: 0 - #1 is filed before H - #2, before He - #3, etc.

A_2. Compounds, including intermetallic compounds: These are divided into groups which are determined by the element in the compound with the largest order number. Subsets within this group are then determined by the element with the next to highest number, etc. To this end, each compound is characterized by the set of order numbers (called index or finding numbers) of its elements written in order of decreasing order number.

For example:

Name	Formula	Index
Sodium oxide	Na_2O*	99-1
Sodium hydroxide	NaOH	99-2-1
Sodium fluoride	NaF	99-9
Sodium chloride	NaCl	99-10
Sodium sulfate	Na_2SO_4	99-14-1
Sodium carbonate	Na_2CO_3	99-23-1

*Note that the automatic printer used for the data pages is restricted to capital letters, so that the molecular formulas must be written with their elements separated by dashes or brackets: Na_2O becomes NA2-O, etc.

These are all members of the group filed under sodium in the above order. All potassium compounds (#100) containing elements with numbers not larger than 100 follow this group, while all lithium compounds containing elements with numbers not larger than 98 precede the sodium group, etc.

The only compounds excluded from this category are those with two or more carbon atoms (#23) and no elements above #23. These are filed separately under categories B and C.

B. Hydrocarbons: Organic compounds containing only C (#23) and H (#2). For example:

Name	Formula	Index
Methane	CH_4	23-2 (1-4)
Benzene	C_6H_6	23-2 (6-6)
Hexane	C_6H_8	23-2 (6-8)
Octane	C_8H_{10}	23-2 (6-10)

are listed in the above order. Therefore, in order to find a hydrocarbon, one must first find the set containing the correct number of carbon atoms and, second, the compound with the proper number of hydrogen atoms of that set. Polymers are filed under the monomer.

C. All other organic compounds: Compounds with more than two carbon atoms (#23) and no element with order number larger than 23.

D. Alloys, solutions, and mixtures: Materials that are not simple compounds and that contain no component (element or compound) over 90 mole percent. Those that contain a component over 90 mole percent will be listed under A_1, A_2, B, or C to avoid scattering almost pure materials under different headings.

The finding number may be a compound number derived from the constituent compounds. The leading index will be that of the major constituent — not necessarily the one containing the largest order number.

For example:

41-24-1--93-24-1

Olivine

(Name)	(Formula)	(Composition)
Fayalite	Fe_2SiO_4	55.0%
Forsterite	Mg_2SiO_4	45.0%

In this case, the compound index consists of the indexes of two minerals (Fayalite and Forsterite). These indexes are of necessity complex, but they allow for a minimum amount of conflict in filing order. No distinction has, so far, been made between solutions and granular mixtures in generating the index numbers.

The above example forms the heading for the data page of the particular rock.

A large number of the materials studied have not been characterized sufficiently to allow assignment of a finding number. These materials are, however, useful for many engineering applications. They are synthetic composites and geological materials and are generally categorized as mixtures or organic plastics. A separate section has been provided for these materials at the end of this compendium.

Techniques

Experimental:

A. Pin: The surface accelerated by the shock wave under study may be used as one pole of a switch. The value and complexity of this technique for locating shock and free-surface position as a function of time are well illustrated by the experiments on iron of Bancroft et al.[7] In these experiments, the switch completes a current path and causes a capacitor to discharge. Alternatively, a voltage or current pulse may be produced by a ferroelectric or piezoelectric crystal on impact with a surface. A description of some pin types has been given by van Thiel and Alder.[8]

B. Optical flash: The moving surface may be used to compress a thin layer (0.01-0.1 mm) of argon or xenon gas. This shock compression results in a flash which is then recorded by a smear camera. This technique has been adequately described by Rice et al.[1] and by McQueen et al.[9]

C_1. Reflectivity change of a mirror: An optically reflecting surface will turn opaque when impacted with sufficient strength by a shocked material. A smear camera is focused on a mirror placed on the surface to be shocked or some distance from it and records arrival of the shock wave or the free surface, respectively.[2]

C_2. **Turning mirror:** Frequently surface structure of shock strength is such that the surface of the mirror does not change reflectivity rapidly enough. In this case, the mirror may be placed at an angle to the shock front or surface. Impact then causes the mirror to turn through an angle, thus removing a parallel beam of light from the optical path. This technique is more reliable for smooth surfaces than technique C_1 but requires more care in the optical setup.[2]

C_3. Total reflection of a prism[10]: This is a variation of the mirror technique. Closing a void (as small as a micron) between a sample and a glass or other transparent prism will change the angle of total internal reflection. A beam of light reflected internally close to the critical angle will, therefore, be rapidly cut off when the void is closed. The prism may be placed either on the surface or at some angle to it to determine either the arrival time of the shock or the velocity of the surface.

D. "Optical lever": The optical-lever technique employs the change of position of an optical image in a reflecting surface when this surface is turned by a shock wave. In this case, the shock front makes a known finite angle with the surface. The measurement of the displacement of a series of images made by different parts of the surface and the observation of the time of displacement of these images yields the required shock and free-surface parameters.[2]

E. "Knife edge": The knife-edge or moving-image technique yields higher spatial resolution than the optical-lever technique. Here a thin wire or knife edge is suspended over the polished surface of the specimen. The separation of the knife edge and its image may be photographed as a function of time to yield the surface velocity. This technique was first reported by Davis and Craig.[11]

F. Resistance wire: This technique, first described in a Sandia Laboratories report,[12] has been used to measure free-surface velocity. Here a change of resistance is measured as the moving surface shorts out a resistance wire positioned at an angle to the surface. The velocity of the free surface is then obtained from the resistance-time record. Shock velocity may be obtained if the wire is parallel to the surface and the shock direction is other than normal.

G. Capacitor: The capacitor technique measures the change of capacitance of a parallel plate capacitor, one plate of which is the surface whose velocity is to be measured.[13]

H. Polarization: The polarization technique[14] uses the shape of an electrical pulse produced by the shock to measure shock velocity in cases where the shock wave changes the dielectric polarization of the sample.

I. Transducer: While the above techniques measure shock or surface motion, several transducer techniques that give pressure directly have been developed or are under development. In these cases, a measured voltage change is related to pressure by calibration against one of the primary techniques mentioned above. Some examples are:

- Conductivity gauge: The sulfur gauge was first developed by Eichelberger and Hauver.[15] It is based on the change of conductivity of a sulfur wafer with pressure. Another useful material for pressure measurement is manganin wire, used previously in static work because of its linear pressure versus resistivity curve. Some work has been done to extend this curve to higher pressures.[16]
- Piezoelectric gauge: The quartz gauge[17] and the lithium niobate gauge,[18] which are based on the piezoelectric coefficient, yield useful pressure measurements up to about 50 kbar and 15 kbar, respectively. A calibration curve may be obtained from R. A. Graham, Sandia Laboratories, Albuquerque. Tourmaline has been used and a calibration up to 21 kbar[19] has been reported.

J. Radiographic methods: These may measure either one of two sets of parameters.

- The shock velocity and density change across the shock front. This method has been described by Schall.[20]
- The shock velocity and the velocity of an embedded foil of higher specific absorption index. This method is valuable in that it yields P, V, and E points independently of a model or a standard material. Its limitations lie in the relatively poor shock front resolution.

K. Magnetic induction: This may be used in interface and free-surface velocity measurements.

- A current loop made of foil or flattened wire may be embedded in a nonconducting sample or placed at an interface.[21,22] The voltage induced in the wire when the wire is moved through an externally applied uniform magnetic field is a measure of material velocity.
- Similarly, a voltage may be induced in a current loop placed concentric to a magnetic pole and close to a moving surface.[23] This method is relatively inexpensive and may be used to measure the motion of any metallic-nonmetallic interface.

Data Reduction:

The parameters obtained from most experimental techniques used to date are shock velocity (U_s) and surface velocity (U_{fs}). The surface velocity may be either the velocity of a projectile generating pressure in the sample (Fig. 2) or the velocity of the sample surface after the shock has traveled through the sample. The pressure change $P - P_0 = \rho_0 U_s U_p$ is a function of shock velocity and the change of mass velocity across the front. Techniques for calculating this latter velocity are discussed below.

A. If the projectile and the sample (Fig. 2(a)) are made of the same material, the shock velocity in the sample and in the projectile (relative to the unshocked medium in front of the wave) is the same. Therefore, the dynamic impedance $\rho_0 U_s = P/U_p$, $\tan\theta_1 = \tan\theta_2$, where from symmetry (Fig. 2(b)) U_p is equal to one-half the projectile velocity before impact and equal to the change of mass velocity across the wave. If the projectile and the sample are not the same, the projectile Hugoniot (H_2) is used as a known standard (Fig. 2(c)).

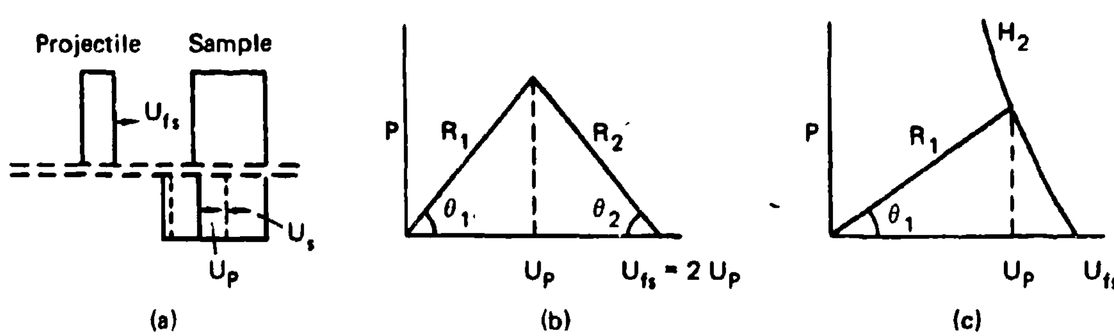


Fig. 2. Velocity diagrams.

The solution is then given by the intersection of R_1 and H_2. The equations to be solved are therefore:

In Fig. 2(b):

$$- P_0)_{sample} = (\rho_0\ U_s) \qquad (1a)$$

and

$$^{\text{ρ}} - P_0)_{projectile} = (\rho_0\ U_s)\ (U_{fs} - U_p). \qquad (1b)$$

Or i g. 2(c):

$$P_0)_{sample} = (\rho_0\ U_s)\ U_p, \qquad (1c)$$

and the equation of the projectile Hugoniot

$$(P - P_0)_{projectile} = f(U_{fs} - U_p). \qquad (2)$$

B_1. Where the velocity of a projectile is not measured, the sample is positioned on a plate (the standard) with a known Hugoniot locus (H) and unloading isentropes (a). As is shown in Fig. 3, the solution is given by the dynamic impendance condition of the sample

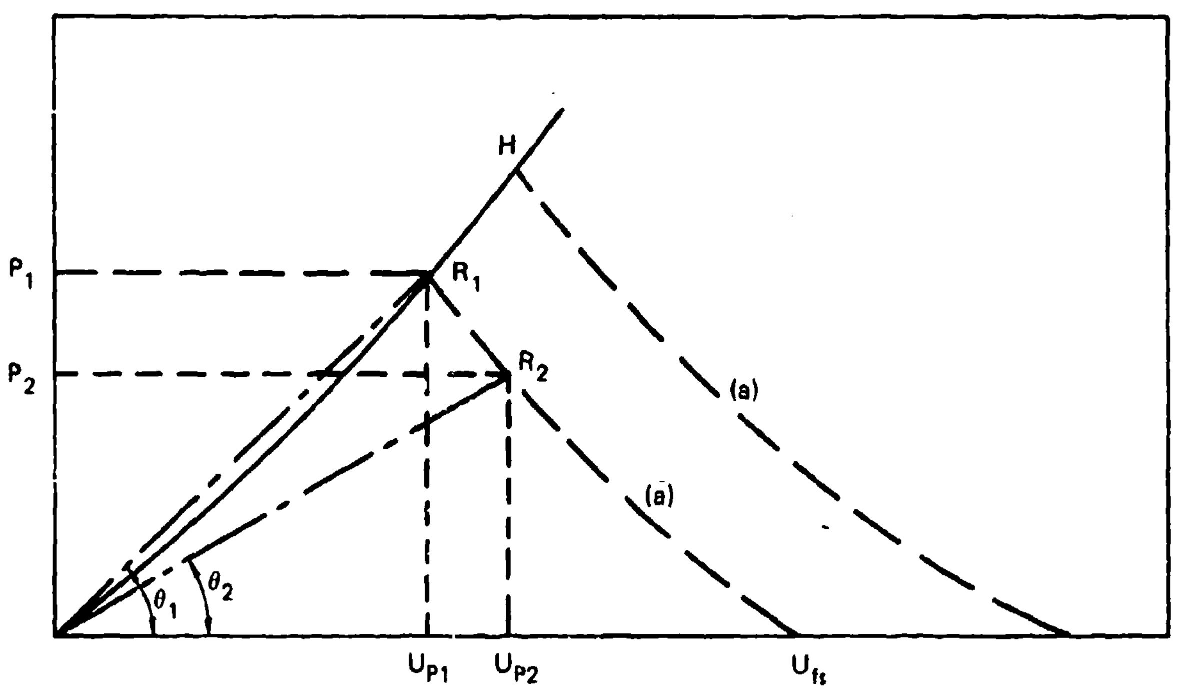


Fig. 3. Projectile velocity.

($\tan\theta_1 = \rho_0 U_s$), and the particular unloading path (a) that crosses the Hugoniot point of the plate at the experimental pressure (P_1). The latter is selected on the basis of a measurement of U_{fs} or $\rho_0 U_s = \tan\theta_1$ of the plate. The solution of P_1 and U_{p1} is, therefore, obtained from:

$$P_2 - P_0 = \Delta P \text{ (sample)} = (\tan\theta_2)\, U_{p2} \tag{1d}$$

and the equation of the unloading adiabat

$$\begin{aligned} P_2 = P_a \text{ (plate)} &= f_a\, (U_s, U_{fs} - U_{p2}) \\ &= f'_a\, (U_{fs}, U_{fs} - U_{p2}). \end{aligned} \tag{3}$$

B_2. A modification of technique B_1 places the material with known equation of state on the sample. The measured quantities are usually the shock and (or) free-surface velocity of the known standard and the shock velocity of the unknown. Consider P_2 as the known pressure and P_1 as the pressure to be determined (Fig. 3). Since the cross curve (a) is not known in this case, the acoustic approximation angle

$$P_2R_2R_1 \simeq \theta_1 = \rho_1\, U_{s_1} \tag{4}$$

may be made to yield a first-order solution

$$P_1/P_2 = (\theta_1 + \theta_2)/2\theta_2. \tag{5}$$

After several points are thus obtained, the solution may be improved by iteration. When the shock front is not parallel to the sample-standard interface, appropriate components must be used.[24]

C. Where the pressure is measured directly with a transducer, the other parameter usually measured is the shock velocity through the sample. The conservation of mass and momentum conditions mentioned before may be rearranged to give

$$V/V_0 = 1 - \frac{U_P}{U_s} = 1 - \frac{P - P_0}{\rho_0 U_s^2} . \tag{6}$$

Once P and V are known, conservation of energy then yields the energy change

$$E - E_0 = 1/2\, (P_0 + P)\, (V_0 - V) . \tag{7}$$

D. If only U_s and U_{fs} are available from a set of experiments, a Hugoniot may be obtained with:

- The assumption that $U_p = 1/2\ U_{fs}$. This is a good approximation at sufficiently low shock compression.
- Otherwise, a model of the thermal expansion or thermal pressure coefficient is used to calculate adiabats from an assumed Hugoniot. A first-order estimate may be the first assumption above.

The Rieman integral

$$U_r = \int_{V_0}^{V} \sqrt{\left|\frac{\partial P}{\partial V}\right|}\, dV$$

along an isentrope is then assumed to yield the increase in mass velocity when shocked material, initially at some pressure P_1 and particle velocity U_p (Fig. 3), unloads to P_0 and $U_{fs} = U_p + U_r$. These techniques have been discussed in detail by Walsh[25] and by Al'tshuler.[26]

This model assumes equilibrium within the state considered. Some uncertainty exists at the time of this writing on how to treat small but measurable effects due to slow relaxation processes behind or in a shock wave. These may be important near-phase transitions or in the pressure range of elastic yield.

E. Where a radiographic method has given U_s and V/V_0, U_p is obtained directly from Eq. (6) and P from the pressure equation given on page 1.

F. The before-mentioned conservation conditions may be applied without rearranging where U_s and U_p are given directly.

G. If a transducer with a known Hugoniot equation ($U_s = F(P)$, $U_p = F(P)$) like quartz is impacted onto the sample or is impacted by the unknown, all required quantities can be calculated from a measure of P and impact velocity, since $P(tr) = P(sa)$, and $U_p(sa) = U - U_p(tr)$, where tr is the transducer, sa is the sample and U is the impact velocity.

Table 1. Order of the elements.

Actinium	Ac	91	Indium	In	31
Aluminum	Al	29	Iodine	I	12
Americium	Am	85	Iridium	Ir	46
Antimony (Stibium)	Sb	21	Iron	Fe	41
Argon	Ar	5	Krypton	Kr	6
Arsenic	As	20	Lanthanum	La	76
Astatine	At	13	Lead	Pb	27
Barium	Ba	96	Lithium	Li	98
Berkelium	Bk	83	Lutetium	Lu	62
Beryllium	Be	92	Lawrencium	Lw	77
Bismuth	Bi	22	Magnesium	Mg	93
Boron	B	28	Manganese	Mn	48
Bromine	Br	11	Mendelevium	Mv	79
Cadmium	Cd	34	Mercury (Hydrargyrum)	Hg	35
Calcium	Ca	94	Molybdenum	Mo	52
Californium	Cf	82	Neodymium	Nd	73
Carbon	C	23	Neon	Ne	4
Cerium	Ce	75	Neptunium	Np	87
Cesium	Cs	102	Nickel	Ni	39
Chlorine	Cl	10	Niobium (Columbium)	Nb	55
Chromium	Cr	51	Nitrogen	N	18
Cobalt	Co	40	Nobelium	No	78
Copper	Cu	36	Osmium	Os	47
Curium	Cm	84	Oxygen	O	1
Dysprosium	Dy	67	Palladium	Pd	42
Einsteinium	D	81	Phosphorus	P	19
Erbium	Er	65	Platinum	Pt	45
Europium	Eu	70	Plutonium	Pu	86
Fermium	Fm	80	Polonium	Po	17
Fluorine	F	9	Potassium (Kalium)	K	74
Francium	Fr	103	Promethium	Pm	72
Gadolinium	Gd	69	Protactinium	Pa	89
Gallium	Ga	30	Praseodymium	Pr	74
Germanium	Ge	25	Radium	Ra	97
Gold	Au	38	Radon	Rn	8
Hafnium	Hf	59	Rhenium	Re	50
Helium	He	3	Rhodium	Rh	43
Hydrogen	H	2	Rubidium	Rb	101
Holmium	Ho	66	Ruthenium	Ru	44

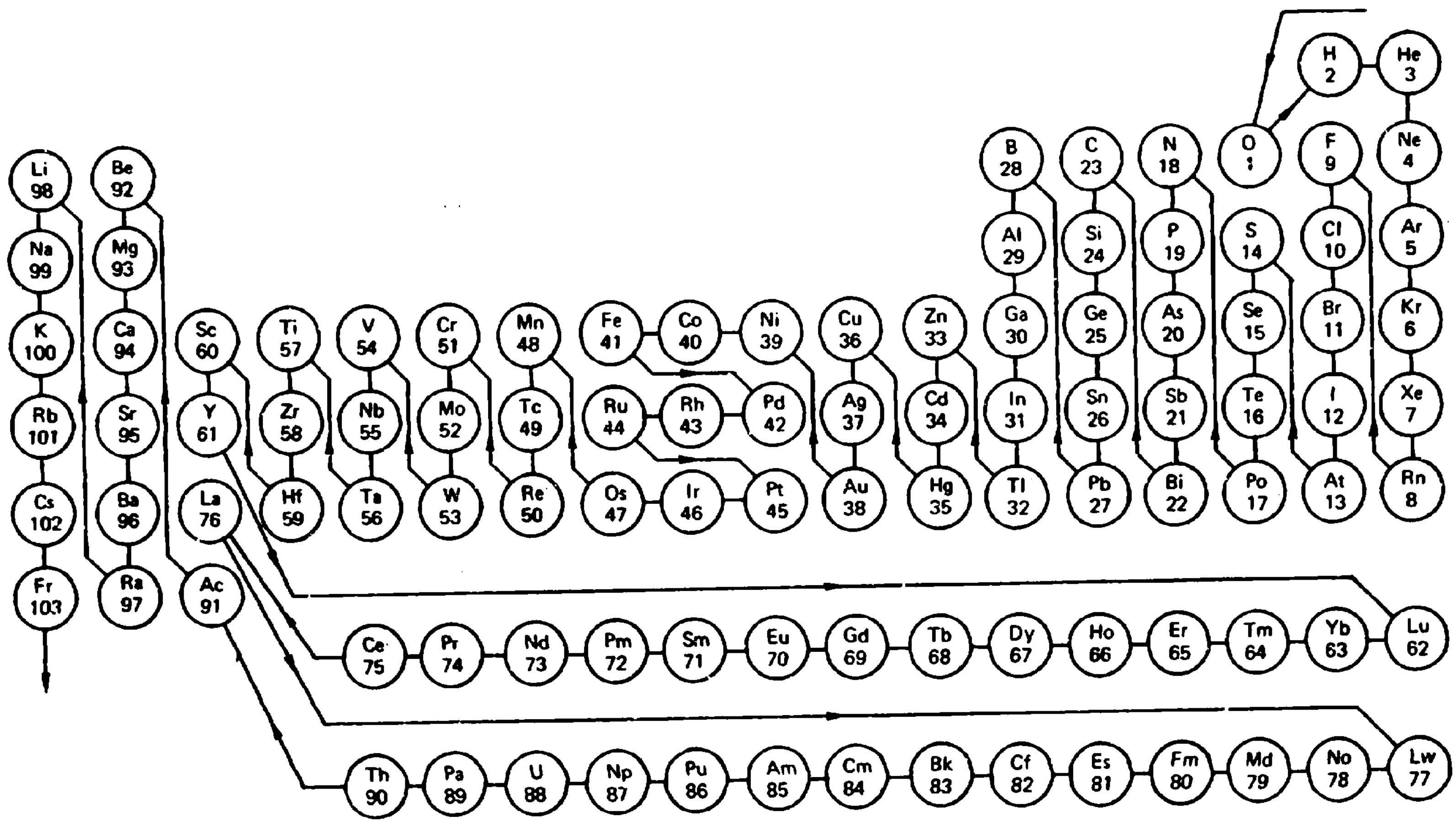


Fig. 4. Standard order of arrangement of the chemical elements.

References

1. M. H. Rice, R. G. McQueen, and J. M. Walsh, *Solid State Phys.* 6, 1 (1958).
2. G. E. Duval and G. R. Fowles, "Shock Waves," in *High-Pressure Physics and Chemistry*, R. S. Bradley, Ed. (Academic Press, London and New York, 1963), vol. 2.
3. Ya B. Zeldovich, Wallace D. Hayes, and R. F. Probstein, *Physics of Shock Waves and High-Temperature Hydrodynamic Phenomena* (Academic Press, London and New York, 1967), vols. 1 and 2.
4. R. Courant and K. O. Friedrichs, *Supersonic Flow and Shock Waves* (Inter-science Publishers, Inc., New York, 1967), vol. 1.
5. Consolidated index of selected property values. Physical Chemistry and Thermodynamics, Publication 976, National Academy of Science, Washington, D.C. (1962).
6. F. D. Rossini, "Chemical Thermodynamic Tables," National Research Council — National Academy of Science Conference on Standard Reference Data for Thermodynamics, 1964. See also D. D. Wagman, et al., *Selected Values of Chemical and Thermodynamic Properties*, National Bureau of Standards, Rept. T.N. 270-3(1968).
7. D. Bancroft, E. L. Peterson, and S. Minshall, *J. Appl. Phys.* 27, 291 (1965).
8. M. van Thiel and B. J. Alder, *J. Chem. Phys.* 44, 1056 (1966).
9. R. G. McQueen et al., "Equation of State of Solids," in *High Velocity Impact Phenomena*, R. Kinslow, Ed. (Academic Press, London and New York, 1970).
10. G. Eden and P. W. Wright, "Technique for the Precise Measurement of a Plane Free Surface," in *Proc. 4th Symp. (Intern.) Detonation* (U.S. Naval Ordnance Laboratory, 1965). This paper can be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., U.S.A 204021.
11. W. C. Davis and B. G. Craig, *Rev. Sci. Instrum.* 32, 579 (1961).
12. L. M. Barker and R. E. Hollenbach, *Rev. Sci. Instrum.* 35, 742 (1964).
13. M. H. Rice, *Rev. Sci. Instrum.* 32, 449 (1961).
14. G. Hauver and A. Melani, *BRL Report No. 1259*, Ballistics Research Laboratories, Aberdeen Proving Grounds, Maryland (1964).

JAC/rj/vt/mla

15. R. J. Eichelberger and G. E. Hauver, *Intern. Colloq. Nat. Center Sci. Res.* 109, 363 (1962). This paper is obtainable from Editions du Centre National de la Recherche Scientifique, 15, Quai Anatole-France-Paris (VII).

16. P. J. A. Fuller and J. H. Price, *Brit. J. Appl. Phys.* 15, 751 (1964); B. T. Berstein and D. D. Keough, *J. Appl. Phys.* 35, 1471 (1964).

17. R. A. Graham, F. W. Nelson, W. B. Benedick, *J. Appl. Phys.* 36, 1775 (1965).

18. R. A. Graham and R. ~~D.~~ Jacobson, *Appl. Phys. Lett.* 23, 584 (1973).

19. J. Hearst, *J. Appl. Phys.* 36, 3440 (1965).

20. R. Schall, "X-ray Flash Measurements on Shock Waves in Solids," in *Proc. 3rd Intern. Cong. High Speed Photog.* (High Speed Photography, London, 1956).

21. V. M. Zaitsev, P. F. Pokhil, and K. K. Shvedov, *Acad. Sci. USSR Proc. Phys. Chem.* 132, 529 (1960).

22. A. N. Dremin and K. K. Shvedov, *Zh. Prikl. Mekhan i. Tekhn. Fiz.* 2, 154 (1964).

23. J. N. Fritz and J. A. Morgan, *Rev. Sci. Instrum.* 44, 215 (1973).

24. V. M. Boyle, R. L. Jameson, and F. E. Allison, *BRL Report* 1250, Ballistic Research Laboratories, Aberdeen Proving Grounds, Maryland (1964).

25. J. M. Walsh, M. H. Rice, R. G. McQueen, and F. L. Yarger, *Phys. Rev.* 108, 196 (1957).

26. L. V. Al'tshuler, L. V. Kuleshova, and M. N. Pavlovskii, *Soviet Physics, JETP* 12, 10 (1961).

CKL-SOL108 VOL I3 KEV I COMPENDIUM OF SHOCK WAVE
ATA INTRO AND SECTION AI M. VAN THIEL JUN 77
UNC AAN7 - -

1 2 3 4 5 6 7 8 9 10 11 12 13 14

S E C T I O N A1

ELEMENTS

1---1
OXYGEN, LIQUID

O2 WT: PERCENT

TO = 76.9 +OR- 0.2 DEG. KELVIN
VO = 0.8319 +OR- 0.0006 CC/G
CO = 1.01 KM/SEC

IN TABLE I BELOW, DENSITY IS GIVEN IN G/CC AND VELOCITIES IN KM/SEC. MAT. DESIGNATES THE ANVIL MATERIAL FROM WHICH THE FIRST SHOCK IS REFLECTED. NO IS THE EXPERIMENT IDENTIFICATION NUMBER AND P(ST) DENOTES THE STANDARD BASE PLATE PRESSURE. IN TABLE I AND II, (1) AND (2) REPRESENT THE SINGLE AND REFLECTED-SHOCK STATES. IN TABLE II, PRESSURE IS GIVEN IN KILOBARS.

TABLE I

NO	RHOO	US1	UP1	US2	UP2	MAT	P(ST)
1A	1.202	4.60	2.05	3.42	1.51	MG	272
1B	-	-	-	4.13	1.17	AL	-
2A	-	4.60	2.07	3.73	1.17	AL	276
2B	-	-	-	4.86	0.71	CU	-
2C	-	-	-	5.23	0.49	AU	-
3A	-	4.61	2.11	2.25	1.50	MG	283
3B	-	-	-	3.31	1.17	AL	-
3C	-	-	-	4.15	0.69	CU	-
4A	-	5.64	2.62	3.31	2.00	MG	386
4B	-	-	-	4.16	1.58	AL	-
4C	-	-	-	4.25	0.92	CU	-
5A	-	5.41	2.65	4.65	2.08	MG	391
5B	-	-	-	3.97	1.59	AL	-
5C	-	-	-	4.61	0.95	CU	-
6A	-	5.48	2.65	4.31	2.07	MG	392
6B	-	-	-	5.08	1.65	AL	-
6C	-	-	-	4.95	0.66	AU	-
7A	-	5.47	2.69	4.28	0.95	CU	400
7B	-	-	-	4.68	0.66	AU	-
8A	-	5.72	2.90	4.81	1.82	AL	444
8B	-	-	-	4.81	1.08	CU	-
8C	-	-	-	4.77	0.74	AU	-
9A	-	5.89	2.95	3.34	2.29	MG	458
9B	-	-	-	4.66	1.09	CU	-
9C	-	-	-	4.81	0.75	AU	-
10A	-	5.87	2.95	2.43	2.25	MG	461
10B	-	-	-	4.29	1.83	AL	-
10C	-	-	-	3.93	1.05	CU	-
11A	-	6.70	3.61	8.24	3.05	MG	616
11B	-	-	-	4.88	1.41	CU	-
11C	-	-	-	5.16	0.99	AU	-
12A	-	6.75	3.66	4.34	2.96	MG	630
12B	-	-	-	4.98	2.40	AL	-
12C	-	-	-	4.41	1.41	CU	-
13A	-	6.89	3.66	4.56	2.37	AL	633
13B	-	-	-	4.69	1.42	CU	-
13C	-	-	-	4.44	0.97	AU	-

OXYGEN, LIQUID

NO	RHO0	US1	UP1	US2	UP2	MAT	P(ST)
14	-	6.92	3.67	3.29	2.30	AL	636
15A	-	7.50	4.13	6.23	3.47	MG	762
15B	-	-	-	3.58	2.70	AL	-
15C	-	-	-	4.68	1.65	CU	-
16A	-	7.54	4.17	13.20	3.68	MG	772
16B	-	-	-	4.45	1.65	CU	-
16C	-	-	-	5.35	1.19	AU	-
17A	-	7.49	4.22	3.91	2.76	AL	784
17B	-	-	-	4.14	1.66	CU	-
17C	-	-	-	4.11	1.15	AU	-
18A	-	8.06	4.66	5.50	3.20	AL	915
18B		-	-	5.07	1.94	CU	-
18C		-	-	5.20	1.36	AU	-
19A	-	8.09	4.67	2.21	3.78	MG	919
19B	-	-	-	5.37	1.97	CU	-
19C	-	-	-	5.68	1.39	AU	-
20A	-	8.08	4.72	3.72	3.90	MG	931
20B	-	-	-	4.77	3.20	AL	-
20C	-	-	-	5.49	2.00	CU	-

US1 = 1.171 + 1.788*UP1 - 0.6709*UP1**2 KM/SEC
SIGMA US1 = 0.075 KM/SEC.

TABLE II

NO	P1	P2	V1/V0	V2/V0
1A	113.	177.	0.554	0.500
1B	-	231.	0.554	0.475
2A	115.	229.	0.550	0.464
2B	-	321.	0.550	0.442
2C	-	367.	0.550	0.431
3A	117.	176.	0.542	0.466
3B	-	230.	0.542	0.448
3C	-	314.	0.542	0.419
4A	172.	257.	0.520	0.465
4B	-	335.	0.520	0.440
4C	-	442.	0.520	0.391
5A	172.	270.	0.510	0.470
5B	-	339.	0.510	0.428
5C	-	463.	0.510	0.391
6A	174.	268.	0.516	0.473
6B	-	354.	0.516	0.450
6C	-	526.	0.516	0.381
7A	177.	464.	0.508	0.381
7B	-	531.	0.508	0.368
8A	199.	402.	0.493	0.423
8B	-	541.	0.493	0.377
8C	-	603.	0.493	0.354
9A	209.	307.	0.499	0.446
9B	-	550.	0.499	0.377

9C	-	620.	0.499	0.358
10A	209.	300.	0.497	0.433
10B	-	405.	0.497	0.421
10C	-	528.	0.497	0.360
11A	290.	463.	0.461	0.439
11B	-	777.	0.461	0.342
11C	-	889.	0.461	0.323
12A	297.	440.	0.458	0.418
12B	-	583.	0.458	0.391
12C	-	774.	0.458	0.330
13A	303.	575.	0.469	0.395
13B	-	783.	0.469	0.343
13C	-	862.	0.469	0.313
14	305.	549.	0.470	0.377
15A	372.	555.	0.449	0.421
15B	-	687.	0.449	0.366
15C	-	957.	0.449	0.323
16A	377.	606.	0.447	0.434
16B	-	961.	0.447	0.316
16C	-	1140.	0.447	0.307
17A	380.	707.	0.436	0.358
17B	-	969.	0.436	0.303
17C	-	1084.	0.436	0.277
18A	451.	874.	0.422	0.361
18B	-	1205.	0.422	0.304
18C	-	1378.	0.422	0.281
19A	454.	628.	0.423	0.368
19B	-	1225.	0.423	0.309
19C	-	1419.	0.423	0.289
20A	458.	658.	0.416	0.375
20B	-	875.	0.416	0.349
20C	-	1261.	0.416	0.305

COMMENTS:

1) SOURCE: WACKERLE, J, SEITZ, W. L. AND JAMIESON, C. C.
SYMPOSIUM HIGH DYNAMIC PRESSURE, I.U.T.A.M., SEPT. 11-15,1967
PARIS, FRANCE.

2) EXPERIMENTAL TECHNIQUE B. EACH SHOT CONFIGURATION HAD FOUR FLASH-GAP ASSEMBLIES INCORPORATED INTO A COMMON BASE PLATE. ONE ASSEMBLY WAS USED TO MEASURE THE SHOCK STRENGTH IN THE BASE PLATE; THE OTHERS MEASURED INDEPENDENTLY THE SINGLE- AND DOUBLE-SHOCK STATES IN OXYGEN.

DATA REDUCTION TECHNIQUE B. STANDARD MATERIALS USED WERE: ALUMINUM 2024 ALLOY WAS USED AS THE BASE PLATE MATERIAL. THE COVER PLATES WERE AZ31B MAGNESIUM (MG) ALLOY, 2024 ALUMIUM (AL) ALLOY, COPPER (CU) AND GOLD (AU).

3) C0 WAS OBTAINED FROM VAN ITTERBEEK, A. AND VAN DAEL, W., ADV. CRYOGENIC ENG., VOL. 9, PAGE 207 (1963).

4. LIQUID NITROGEN COOLANT WAS USED IN THIS SERIES OF EXPERIMENTS.

5) THE AVERAGE OF THE ESTIMATED ERRORS IN US1 AND UP1 ARE 1.9 AND 1.3 PERCENT RESPECTIVELY, WHILE THE AVERAGE ERROR IN UP2 IS ABOUT 2.0 PERCENT.

TABLE 1

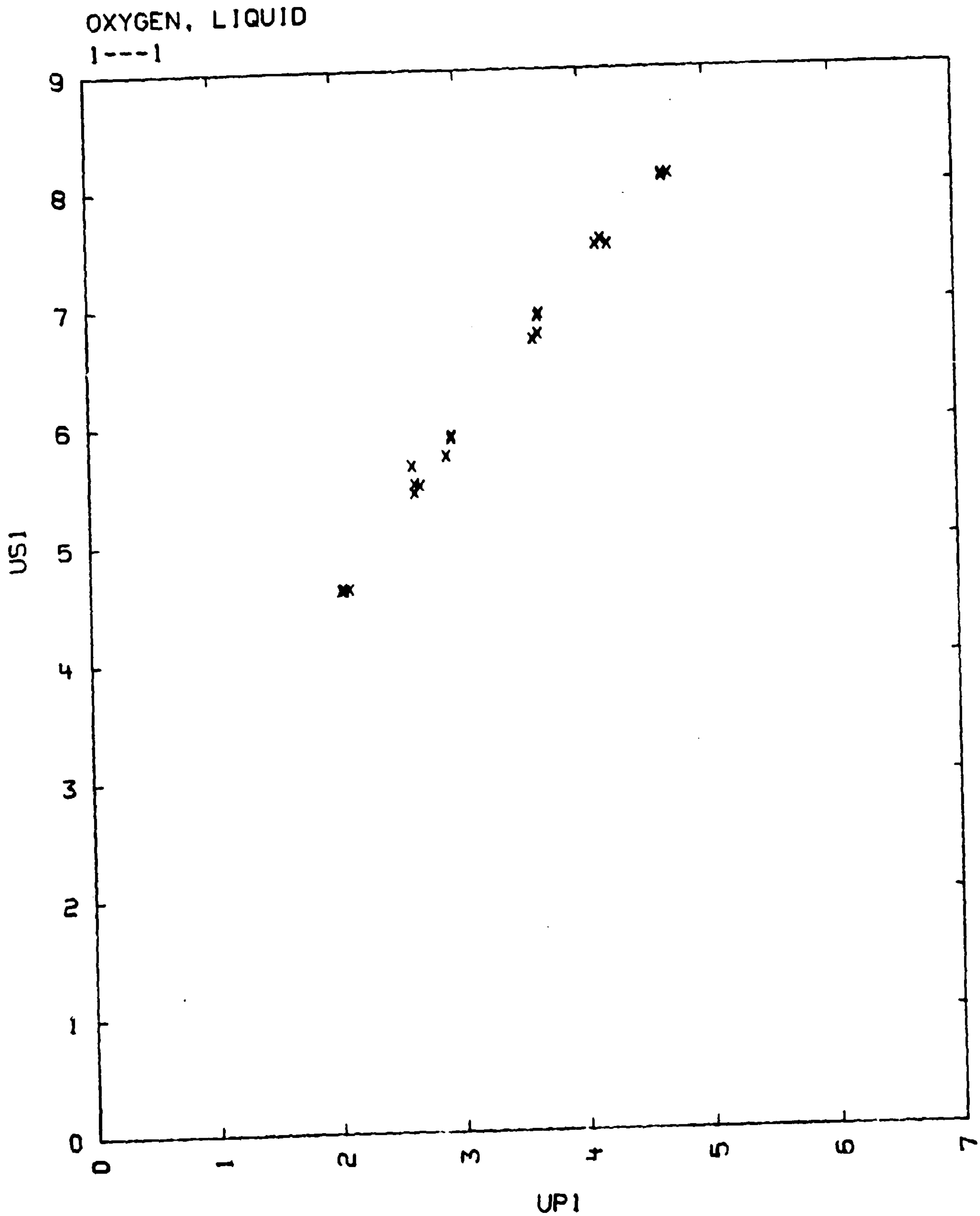
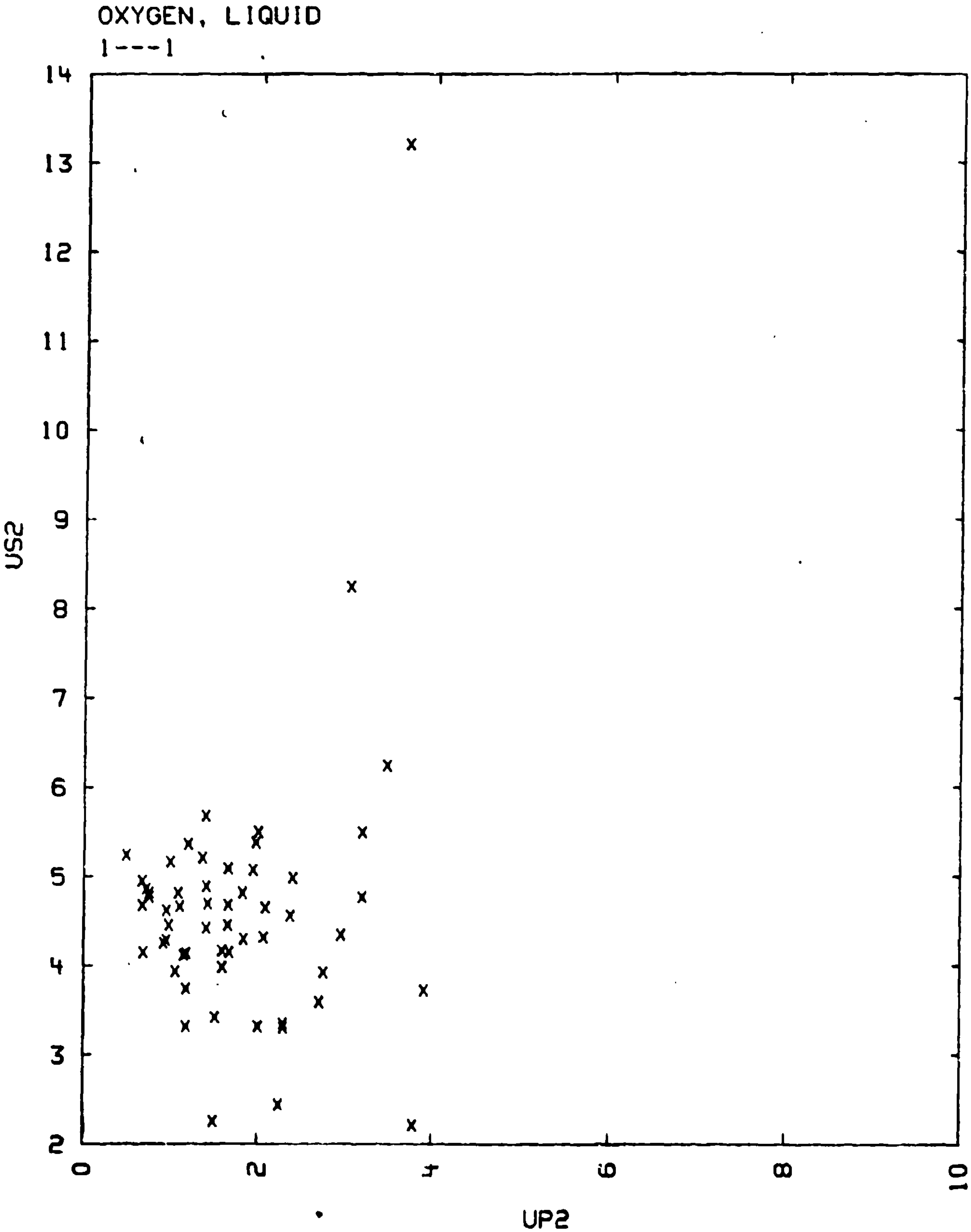


TABLE I



5---1
ARGON

AR GREATER THAN 99.9 PERCENT
N2 LESS THAN .1 PERCENT

TO = 86 DEGR. K.   PO = 1.9 BARS
VO = 0.7117 CC/G   CO = 0.848 KM/SEC

IN THE TABLE, DENSITY IS GIVEN IN G/CC, VELOCITIES IN MM/MICROSEC, AND PRESSURE IN KILOBARS.

TABLE

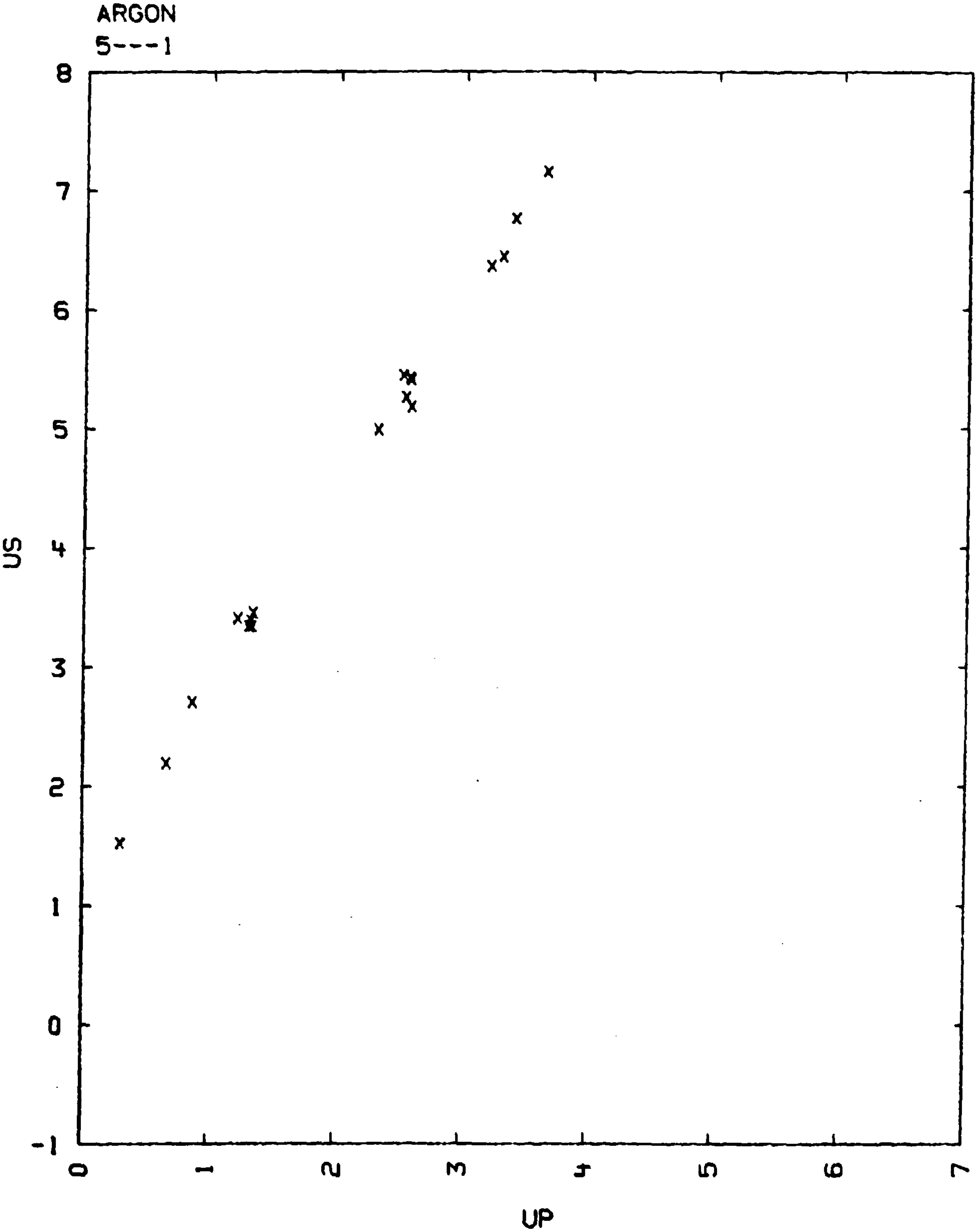
RHOO	US	UP	P	V/VO
1.408	5.44	2.52	194.	.536
1.400	3.40	1.23	58.2	.638
1.403	5.41	2.57	195.	.525
1.405	5.26	2.54	188.	.517
1.408	5.18	2.58	188.	.503
1.406	7.15	3.65	363.	.490
1.409	6.36	3.20	286.	.497
1.401	6.76	3.40	322.	.497
1.405	2.70	0.88	33.0	.673
1.401	4.98	2.32	162.	.535
1.407	1.52	0.301	6.4	.802
1.404	2.19	0.674	20.7	.692
1.406	6.44	3.30	289.	.513
1.407	5.40	2.58	196.	.480
1.405	3.34	1.34	63.0	.519
1.405	3.45	1.35	65.6	.608
1.403	3.38	1.33	63.1	.607
1.403	3.34	1.32	62.1	.603
1.402	3.34	1.33	62.1	.602

US = 0.84 + 2.07 UP MM/MICROSEC   FROM UP = 0.1 TO 1.0
US = 1.19 + 1.627 UP MM/MICROSEC   FROM UP = 1.0 TO 4.0

COMMENTS:

1) SOURCE: VAN THIEL, M. AND ALDER, B.
J. CHEM. PHYS., VOL. 44, P. 1056 (1966)
LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIFORNIA
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE B
(STANDARD MATERIALS: 2024 AL AND AZ-31B MG)
3) THE DATA STRONGLY SUGGEST THE EXISTENCE OF A TRANSITION CLOSE TO THE LIQUIDUS.
4) THE INITIAL SLOPE (US-CO)/UP FOR SMALL VALUES OF UP WAS OBTAINED FROM SONIC MEASUREMENTS BY DOBBS AND FINEGOLD, J. ACCOUSTICAL SOC. OF AMERICA, NO. 32, P 1215 (1960), AND IS 4.0
5) US IS DETERMINED TO A PRECISION OF 2 PERCENT ASSUMING LINEARITY OF

TABLE I



5---2
ARGON

AR GREATER THAN 99.9 PERCENT
N2 LESS THAN 0.1 PERCENT

TO = 148.2 DEGR. K. PO = 70.0 BARS
VO = 1.088 CC/G   CO = 0.35 KM/SEC

IN THE TABLE DENSITY IS LISTED IN G/CC. VELOCITY IN MM/MICROSEC AND PRESSURE IN KILOBARS.

TABLE

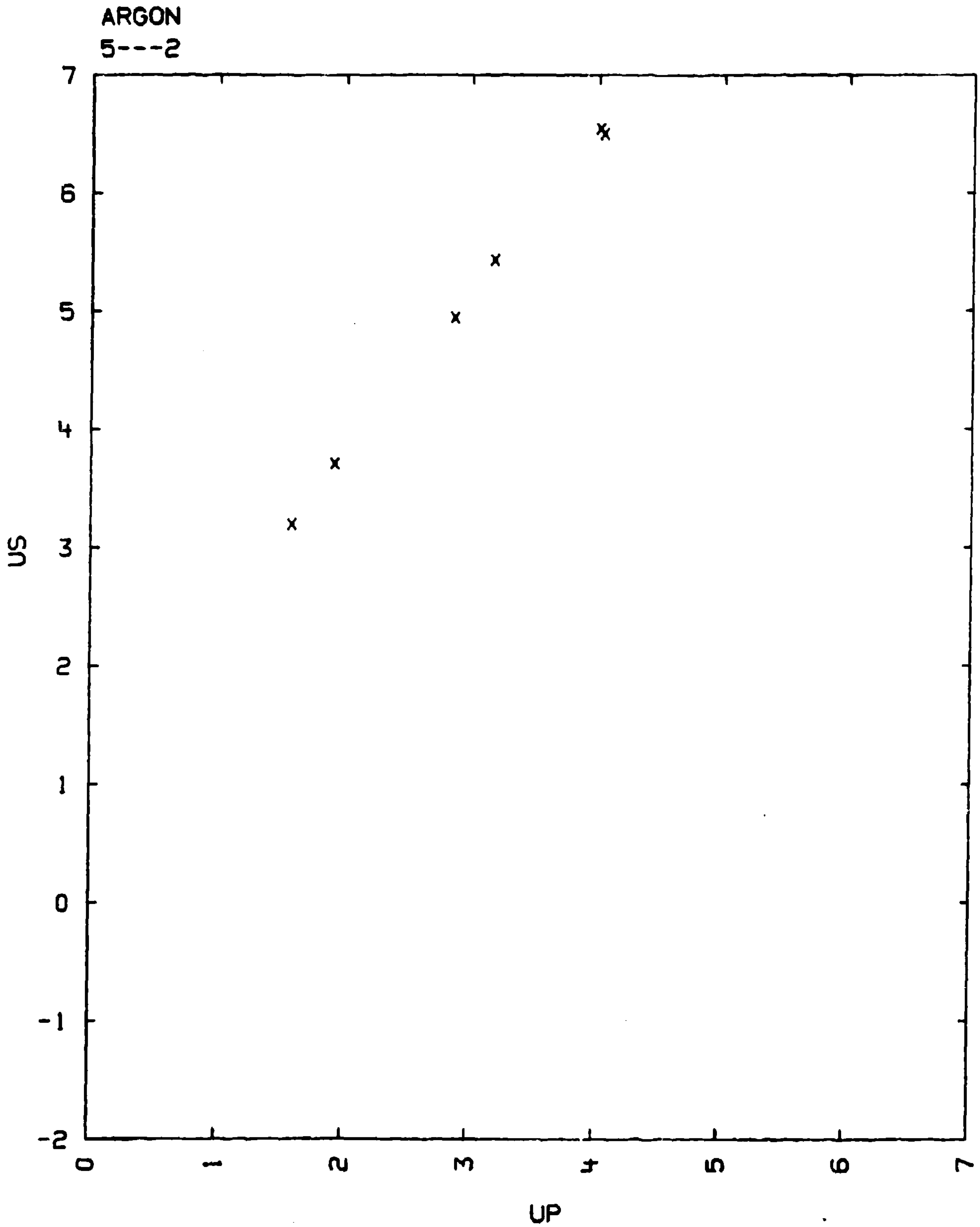
RHOO	US	UP	P	V/VO
.919	3.700	1.923	65.4	.480
.919	5.424	3.188	159.	.412
.919	6.497	4.04	241.	.378
.919	3.183	1.592	46.5	.500
.919	4.934	2.876	130.3	.417
.919	6.54	4.005	240.7	.388

US = 1.036 + 1.368 UP MM/MICROSEC   FROM UP = 1.6 TO 4.2 MM/MICROSEC

COMMENTS:

1) SOURCE: VAN THIEL, M. AND ALDER, B.
J. CHEM. PHYS., VOL. 44, P. 1056 (1966)
LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIFORNIA
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE B
(STANDARD MATERIAL AZ-31B MG)
3) THE INITIAL SLOPE (CO-US)/UP FOR SMALL UP WAS CALCULATED FROM P.V.T. DATA PUBLISHED BY MICHELS ET AL., PHYSICA NO. 24, P 659 FF (1958). THIS YIELDS A SLOPE OF 2.21 AT THE INITIAL WAVE VELOCITY USO=CO=.35 MM/MICROSEC.

TABLE I



5---3
ARGON

AR

TO = 288-301 DEG. K. CO = 0.330 KM/SEC.
VO = 750.6-801.9 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURES IN KILOBARS, DENSITY IN G/CC. AND TEMPERATURE IN DEG. KELVIN.

TABLE

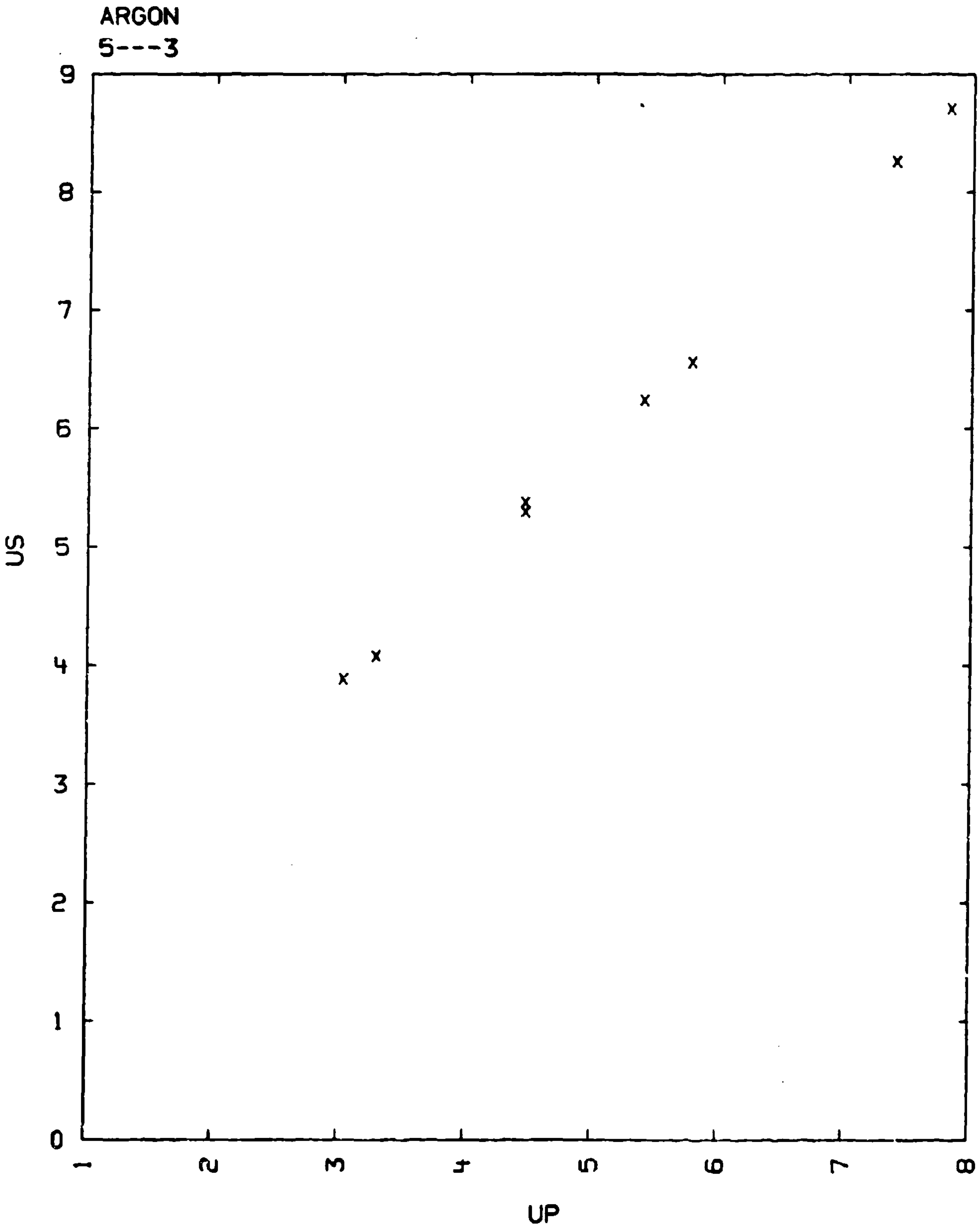
RHOO	TO	PO	US	UP	P	V/VO
0.001307	294	0.0008002	3.877	3.030	0.1543	0.218
0.001249	301	0.0007830	4.076	3.291	0.1683	0.192
0.001328	297	0.0008211	5.290	4.461	0.3142	0.157
0.001248	301	0.0007822	5.365	4.461	0.2995	0.168
0.001307	294	0.0008000	6.230	5.400	0.4405	0.133
0.001298	296	0.0008000	6.550	5.776	0.4922	0.119
0.001332	288	0.0007988	8.260	7.380	0.8128	0.107
0.001247	301	0.0007815	8.700	7.810	0.8481	0.102

US =

COMMENTS:

1) SOURCE: CHRISTIAN, R. H. AND YARGER, F. L.
JOURNAL OF CHEMICAL PHYS., VOL. 23, P. 2042 (1955)
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) THE EXPERIMENTAL ERROR IN THE US MEASUREMENTS IS 0.5 PERCENT.
4) IN THE ABOVE TABLE, RHOO HAS RECOMPUTED FROM THE MEASURED VALVES OF TO AND PO USING THE PERFECT GAS LAW. MEASURED P AND V/VO WERE ALSO RECALCULATED USING THE CONSERVATION CONDITIONS.

TABLE I



5---4
ARGON

AR

TO = 298.3-307.2 DEG. KELVIN
VO = 0.879-1.030 CC/G.

IN THE TABLE BELOW, DENSITIES ARE GIVEN IN G/CC, TEMPERATURE IN DEG. KELVIN, VELOCITIES IN KM/SEC., AND PRESSURES IN KILOBARS.

TABLE

RHOO	TO	PO	US	UP	P	V/VO
0.971	302.2	1.034	2.87	1.42	40	0.546
0.994	299.0	1.074	3.85	1.86	71	0.518
0.972	303.0	1.040	4.72	2.53	117	0.465
0.988	302.7	1.081	4.84	2.66	127	0.460
0.986	307.7	1.110	6.873	4.10	276	0.411
1.138	305.4	1.662	4.968	2.52	144	0.493
1.135	298.3	1.586	6.779	3.97	307	0.414

US = 0.32 + 1.25*(RHOO-1.) + 2.03*UP - 0.11*UP**2. KM/SEC
SIG.US = 0.12 KM/SEC

COMMENTS:

1) SOURCE: WACKERLE, J.
(PRIVATE COMMUNICATION) LOS ALAMOS SCIENTIFIC LAB.,
P.O. BOX 1663, LOS ALAMOS, NEW MEXICO.
2) EXPERIMENTAL TECHNIQUE A AND B.
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) THE MEASURED VALUES FOR THE BULK SOUND VELOCITIES (CO) ARE GIVEN IN THE TABLE BELOW.

TABLE

RHOO	CO
0.971	0.75
0.994	0.77
0.972	0.775
0.988	0.772
0.986	0.775
1.138	0.91
1.135	0.91

4) THE AVERAGE EXPERIMENTAL ERROR IN THE US MEARSUREMENTS DUE TO PROBE SCATTERING IS 1.5 PERCENT, THE LARGEST ERROR IS 4 PERCENT.

5---5
ARGON

AR

T0 = 86 DEG K
V0 = 0.714 G/CC

THE TABLE LISTS DENSITY IN G/CC, VELOCITIES IN KM/SEC AND PRESSURES IN KBAR. 1 AND 2 REFER TO SHOCKS INCIDENT ON AND REFLECTED FROM A HIGHER IMPEDANCE ANVIL. MAT = ANVIL MATERIAL.

TABLE

RHO0	US1	UP1	P1	V1/V0	US2	UP2	P2	V2/V0	MAT
1.40	6.052	3.075	261.	0.492	-3.94	2.034	469.	0.419	AL
-	-	-	-	-	-4.26	1.226	647.	0.368	CU
-	-	-	-	-	-4.67	0.843	753.	0.350	AU
-	6.069	3.093	263.	0.490	-2.95	1.986	454.	0.400	AL
-	-	-	-	-	-3.89	1.213	638.	0.358	CU
-	-	-	-	-	-4.64	0.873	753.	0.350	AU

US=

COMMENTS

1) SOURCE: WACKERLE, J.
PRIVATE COMMUNICATION, GMX-7, LOS ALAMOS SCIENTIFIC LAB.
BOX 1663, LOS ALAMOS, NEW MEXICO. 87544
2) EXPERIMANTAL TECHNIQUE: B
DATA REDUCTION TECHNIQUE: B; STANDARDS: 2024 AL FOR THE BASE PLATE AND 2024 AL, CU AND AU FOR THE ANVILS USED TO REFLECT THE SHOCK.
3) DETAILS OF THE TECHNIQUE ARE DESCRIBED BY: WALSH J. M. AND RICE M. H.
J. CHEM. PHYS., VOL. 26, P. 815, (1957)
4) PRECISION: DEFINE FSIG.A = (SIG.A)/A

BASE PLATE=AL	ANVIL = AL	CU	AU
FSIG.US1=0.02	FSIG.UP2= 0.023	0.015	0.015
FSIG.UP1=0.013	FSIG.P2 = 0.027	0.02	0.018
FSIG.P1 =0.022	FSIG.(V2-V0)=0.053	0.04	0.04
FSIG.(V1-V0)=0.03			

TABLE I

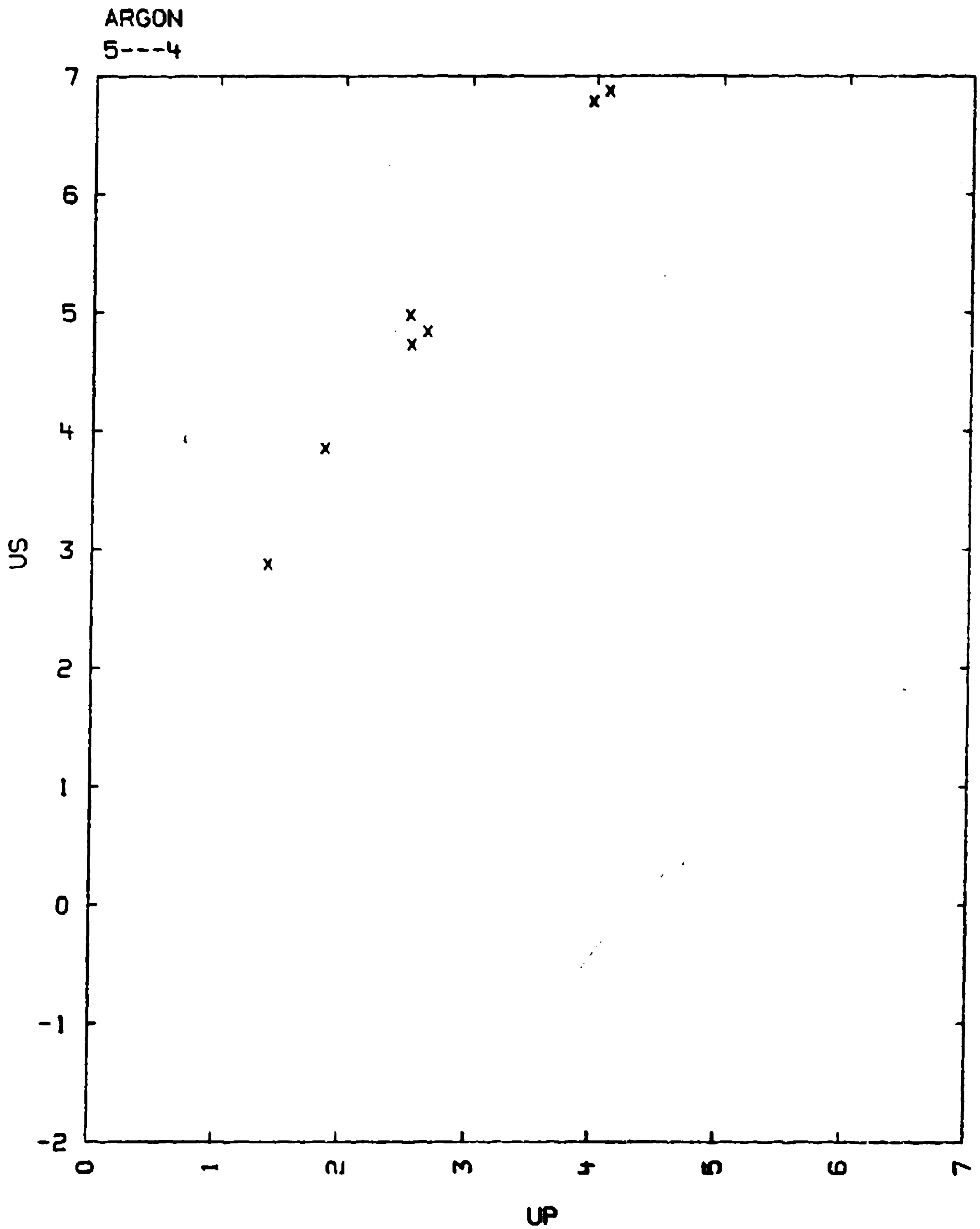


TABLE I

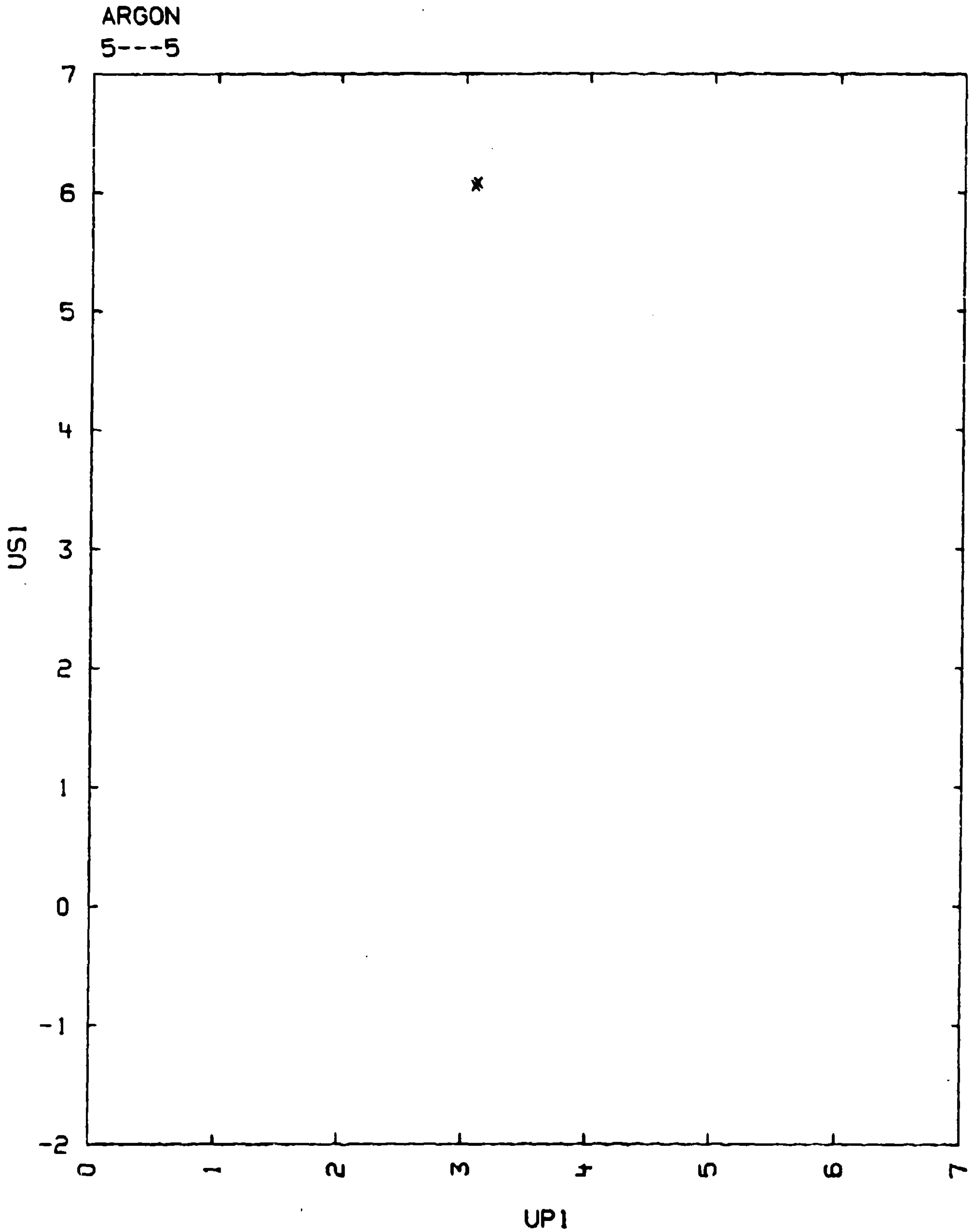
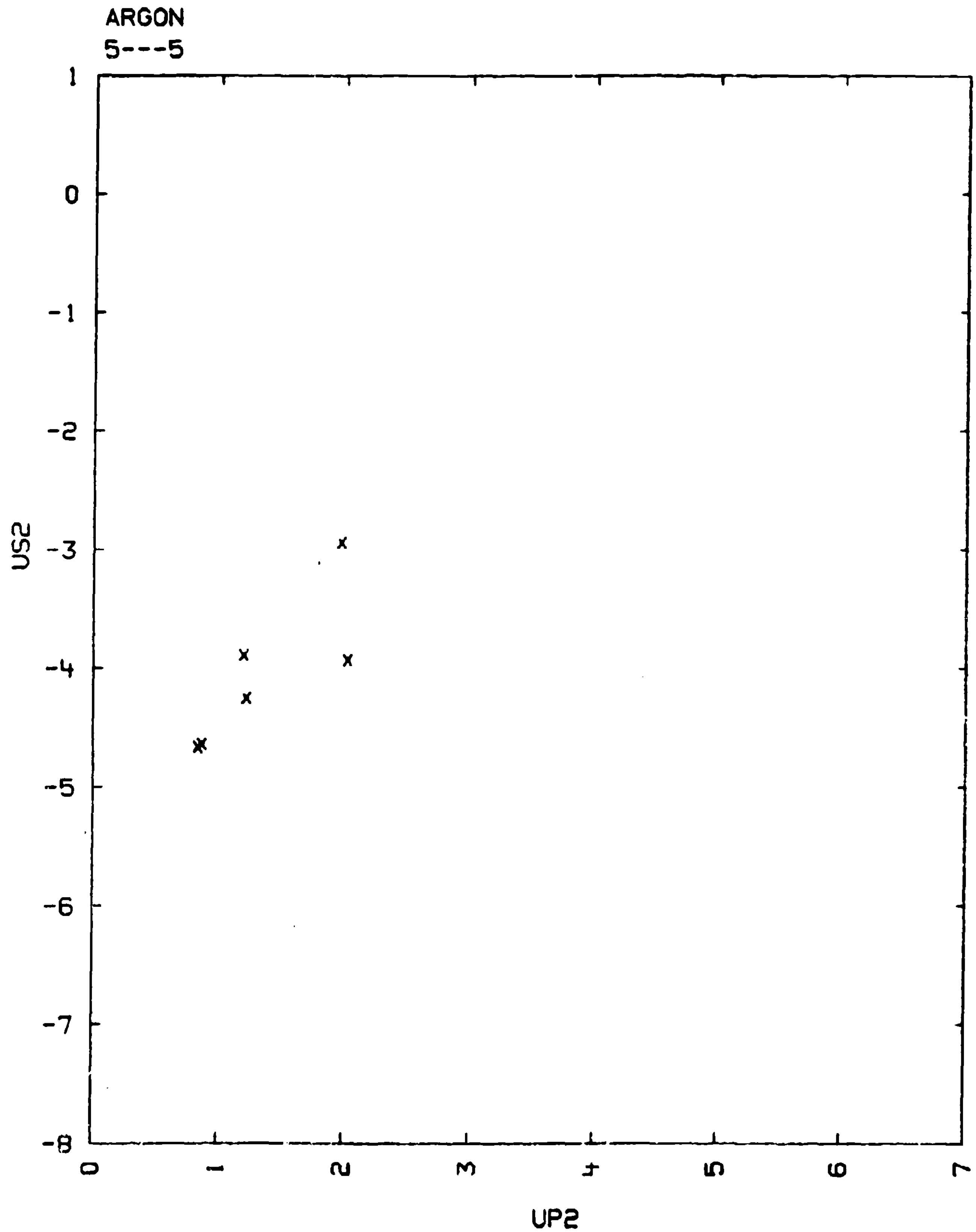


TABLE I



7---1
XENON

XE 99.9 PERCENT

TO = 165.2 DEG. K. PO = 2.24 ATM
VO = 0.3231 CC/G

IN THE TABLE BELOW DENSITY IS GIVEN IN G/CC., VELOCITIES IN KM/SEC AND PRESSURE IN KBARS

TABLE .

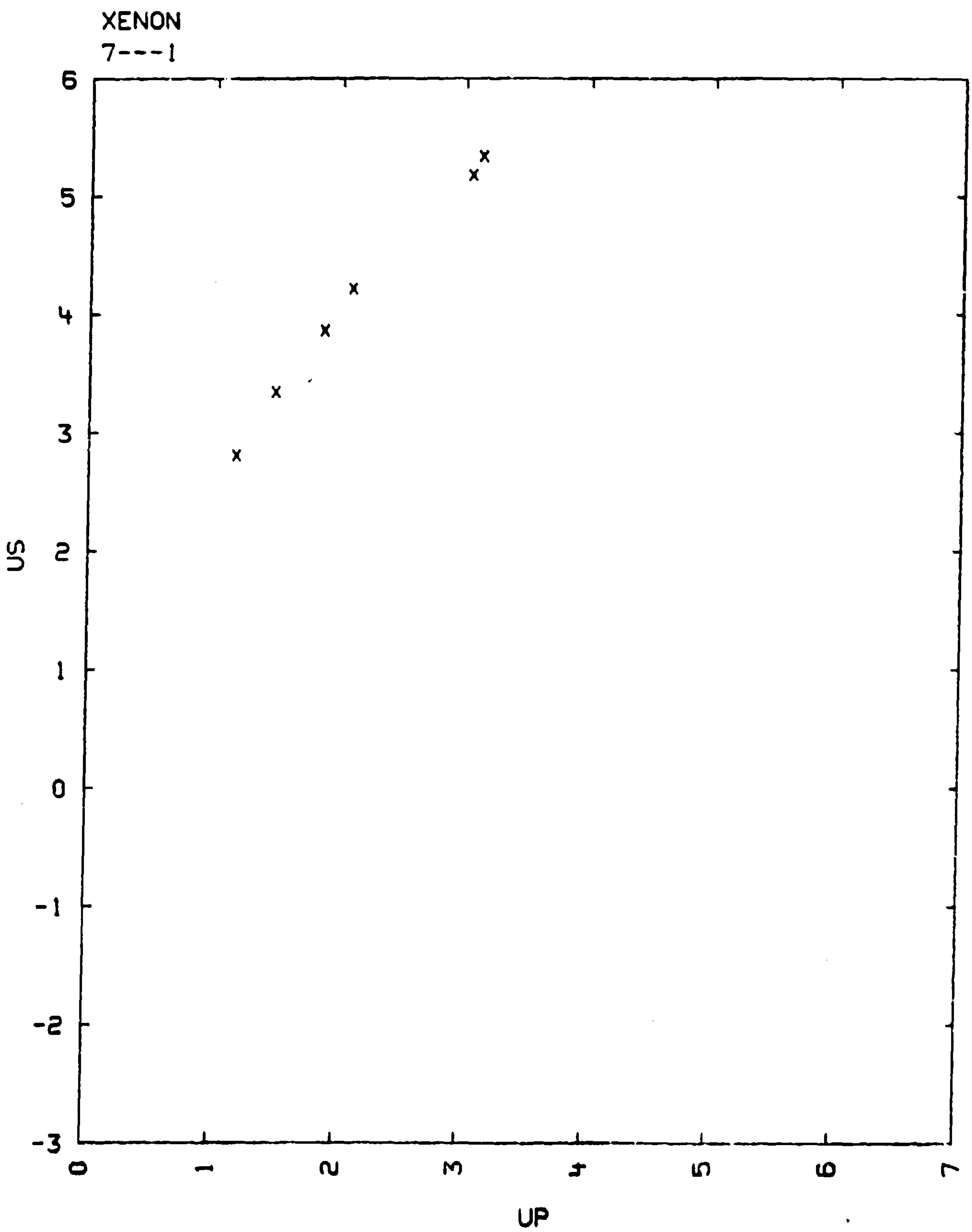
- - - - - - - SAMPLE	- - - - - - -				STANDARD	
RHOO	US	UP	P	V/VO	US	UFS
3.095	2.803	1.185	103	0.578		1.787
3.095	3.334	1.482	153	0.556	6.968	2.329
3.095	3.856	1.87	224	0.510	7.45	3.06
3.095	4.206	2.10	268	0.501	7.654	3.423
3.095	5.177	3.055	487	0.410		5.38
3.095	5.335	3.14	511	0.411	8.912	5.527

US =

COMMENTS:

1) SOURCE: KEELER, R. N.
PRIVATE COMMUNICATION.
LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIFORNIA.
2) EXPERIMENTAL TECHNIQUE: A.
DATA REDUCTION METHOD : B. STANDARD MATERIAL AL 2024.
3) THE SHOCK VELOCITY OF THE STANDARD IN THE FIRST AND FIFTH TABLE ENTRY WAS RELATIVELY INACCURATE AND THEREFORE DISREGARDED IN THE DETERMINATION OF THE ALUMINUM PRESSURE. THE SHOCK AND FREE SURFACE VELOCITY OF THE STANDARD WERE CORPECTED IN THE THIRD TABLE ENTRY (BY -1 AND +1 PERCENT RESPECTIVELY) TO YIELD AGREEMENT WITH THE KNOWN AVERAGE AL. HUGONIOT.
4) A PRELIMINARY DISCUSSION OF THE SIGNIFICANCE OF THIS DATA HAS BEEN GIVEN: R. N. KEELER, M. VAN THIEL AND B. J. ALDER
PHYSICA, VOL. 31, P. 1437 (1965).

TABLE I



12---1
IODINE

I

V0 = 0.2041 CC/G
V01 = 0.2019 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN KM/SEC, AND PRESSURE IN KILOBARS.

TABLE

SAMPLE						BASE PLATE
RHO0	US	UFS	UP	P	V/V0	PRESSURE
4.902	3.78	3.30	1.51	280	0.601	295
4.905	3.74	3.27	1.51	278	0.595	295
4.923	3.40	2.69	1.23	206	0.638	224
4.928	3.34	2.71	1.24	204	0.629	224
4.901	3.04	2.21	1.00	150	0.671	169
4.903	3.02	2.22	1.01	149	0.666	169
4.924	2.98		1.00	147	0.665	168
4.916	2.46	1.48	0.68	82	0.724	101
4.926	2.47	1.48	0.67	82	0.726	101
4.915	3.03	2.26	1.05	156	0.656	177
4.919	3.01	2.22	1.05	155	0.651	177
4.905	3.43	2.75	1.26	212	0.633	230
4.884	5.39	6.11	2.45	644	0.545	616
4.878	4.67	4.79	2.10	478	0.551	479
4.861	4.51	4.28	1.93	423	0.572	423
4.869	2.74	1.98	0.90	120	0.674	138
4.939	4.03	3.90	1.78	354	0.558	369
4.888	5.22	5.74	2.42	617	0.536	596
4.884	4.04	3.70	1.67	330	0.587	343
4.905	3.91	3.59	1.55	298	0.603	311
4.909	3.68	3.10	1.51	273	0.590	292
4.901	3.70	3.17	1.51	273	0.592	292
4.915	5.53	6.21	2.66	723	0.519	688
4.895	5.55	6.28	2.65	720	0.523	688
4.888	5.92	7.10	3.17	917	0.465	884
4.918	5.92	7.09	3.18	926	0.463	888
4.896	6.15	7.50	3.45	1039	0.439	1000
4.878	6.19	7.49	3.43	1036	0.446	993
4.899	4.71	4.96	2.13	491	0.548	488
4.896	4.69	4.72	2.13	489	0.546	488
4.873	5.15		2.46	617	0.522	605
4.844	5.19		2.48	618	0.526	605
4.875	2.94	2.25	1.03	147	0.651	171
4.891	2.90	2.23	1.04	147	0.642	171
4.902	5.16		2.39	604	0.537	584
4.910	5.21		2.37	606	0.545	587
4.890	2.24	1.02	0.49	54	0.780	69
4.879	2.23	1.00	0.50	54	0.777	69
4.916	3.44		1.38	233	0.599	256

IODINE

RHOO	US	UFS	UP	P	V/VO	PRESSURE
4.917	3.47		1.37	234	0.605	256
4.921	3.48		1.37	235	0.606	256
4.871	3.67		1.48	265	0.597	284
4.883	3.60		1.49	262	0.586	284
4.903	3.84		1.58	298	0.589	314
4.916	3.80		1.59	297	0.582	314
4.924	3.82		1.59	298	0.584	314

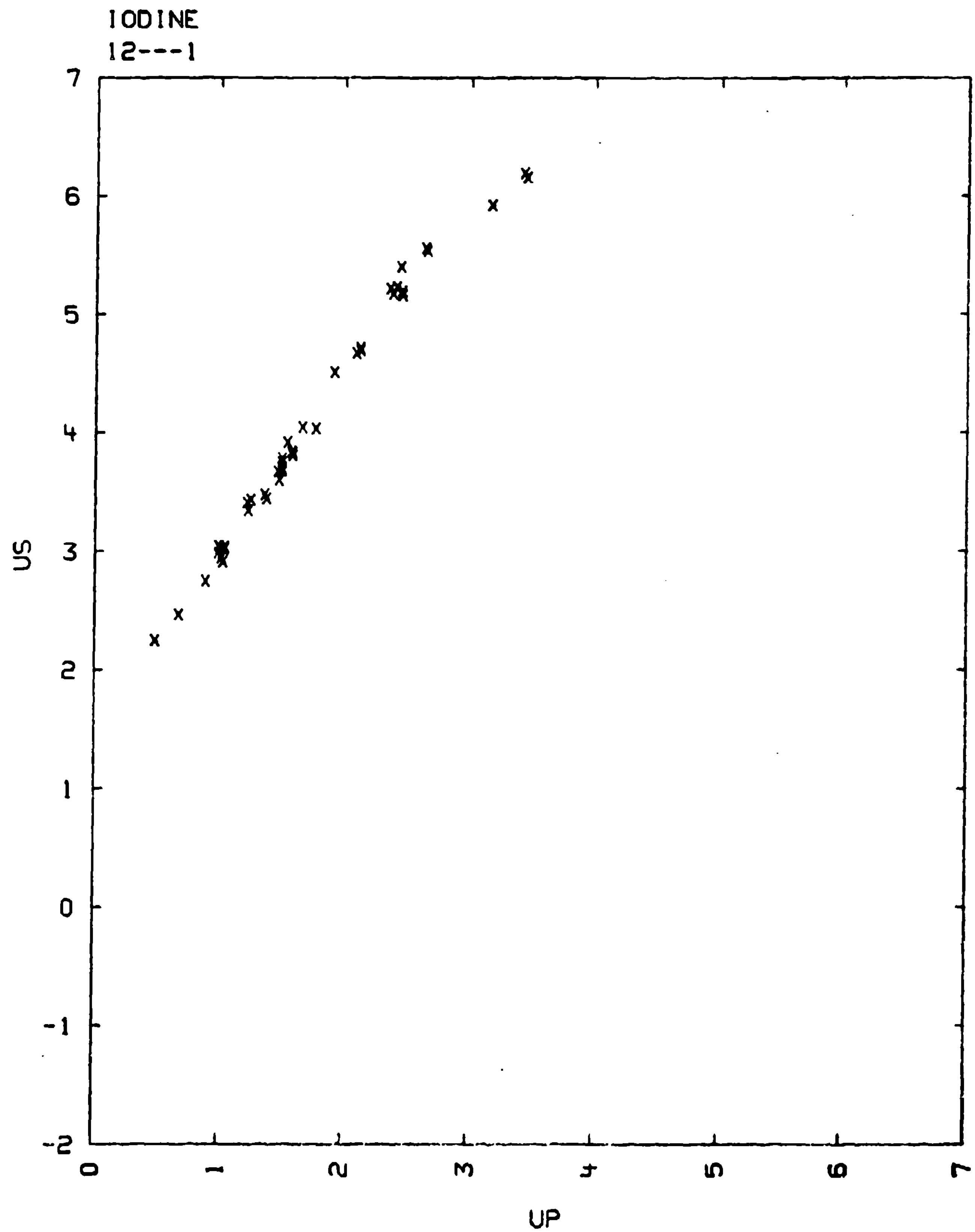
US = 1.38 + 1.56 UP KM/SEC FOR UP BETWEEN 0.5 AND 2.5 KM/SEC
SIGMA US = 0.073 KM/SEC

US = 3.43 + 0.79 UP KM/SEC FOR UP BETWEEN 2.5 AND 3.5 KM/SEC
SIGMA US = 0.031 KM/SEC

COMMENTS:

1) SOURCE: COMPILER
L. R. L. EQUATION OF STATE FILE
LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIFORNIA.
2) EXPERIMENTAL TECHNIQUE B. (ALUMINUM STANDARD BASE PLATE).
DATA REDUCTION TECHNIQUE B.
3) A PHASE TRANSITION IS OBSERVED AT APPROXIMATELY 644 KBAR AND A RELATIVE VOLUME OF 0.545
3) AN EARLIER ANALYSIS AND DISCUSSION OF THIS DATA WAS REPORTED BY B. J. ALDER AND R. H. CHRISTIAN, PHYS. REV. LETTERS VOL. 4, P. 450 (1960).
4) THE VALUE OF VOI WAS OBTAINED FROM A.C.A. MONOGRAPH NO.5, 1963) 2ND EDITION.
CRYSTAL DATA DETERMINATIVE TABLES (AMERICAN CRYSTALLOGRAPHIC ASSOC.)

TABLE I



18---1
NITROGEN LIQUID

N2

TO = 77.4 DEGREES K.
VO = 1.24 CC/G. CO = 0.849 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

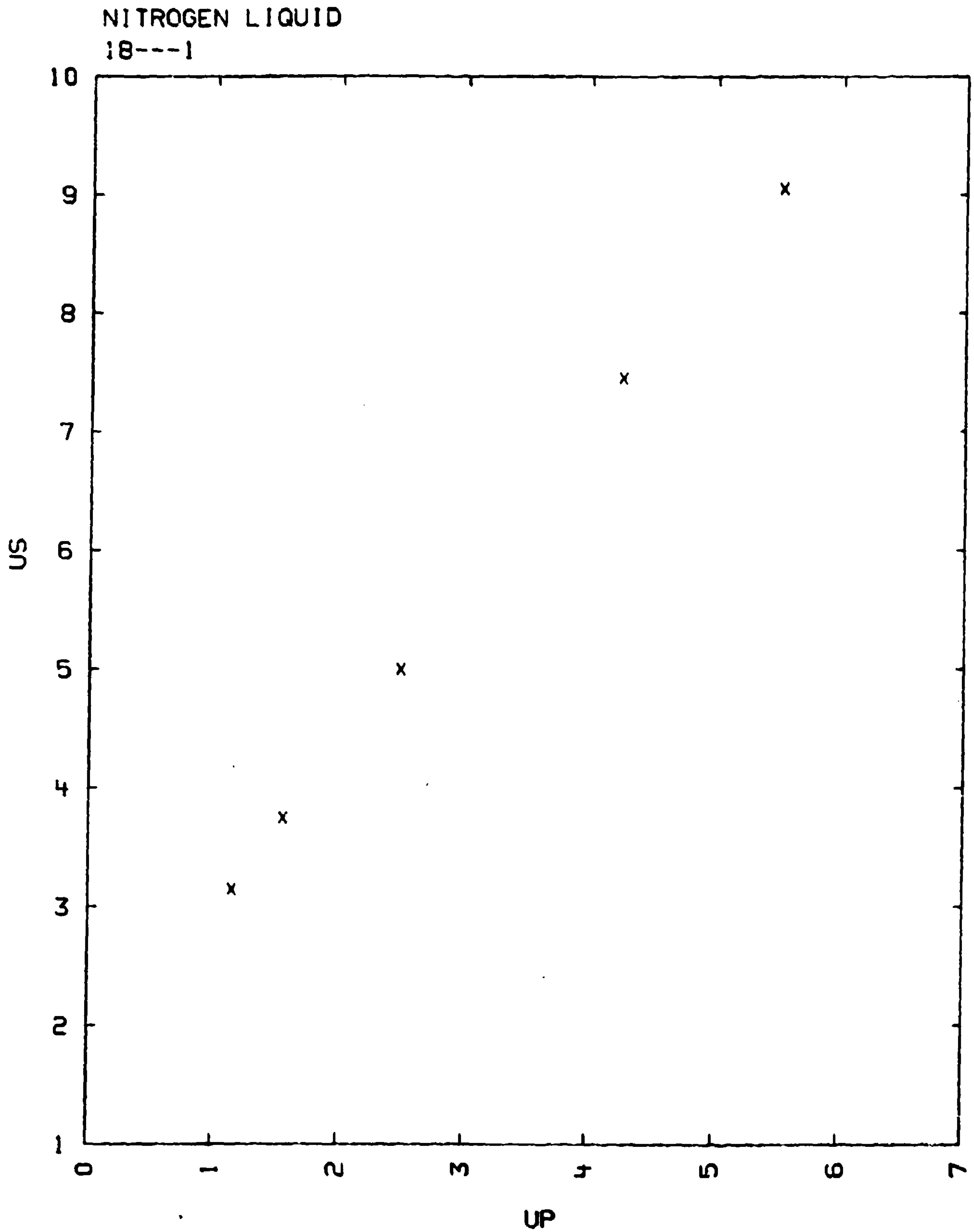
RHOO	US	UP	P	V/VO	UP STANDARD
0.808	3.14	1.17	29.6	0.625	0.69
-	3.74	1.57	47.4	0.580	0.845
-	5.00	2.50	101	0.498	1.55
-	7.45	4.27	257	0.424	2.80
-	9.05	5.52	404.	0.390	3.68

US = 1.588 + 1.360 UP SIGMA = 0.08 PERCENT

COMMENTS:

1) SOURCE: ZUBAREV, V.N. AND TELEGIN, G.S.
SOVIET PHYS.-DOKLADY, VOL. 7, P. 34 (1962)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE B
STANDARD MATERIALS ARE ALUMINUM AND COPPER
3) EACH POINT IS AN AVERAGE OF 4 TO 12 MEASUREMENTS. THE SQUARE DEVIATION FROM THE MEAN IS 1 TO 2 PERCENT.
4) CO IS OBTAINED FROM, DOBBS E. R. AND FINEGOLD L.
THE JOURNAL OF THE ACOUSTICAL SOCIETY OF AMERICA, VOL. 32, NO. 10, P. 1215, OCTOBER, 1960.

TABLE I



18---2
NITROGEN, LIQUID

N2 = N-N

T0 = 77 DEG K
V0 = 1.238 CC/G

C0 = 0.857 KM/SEC.

IN THE TABLE BELOW VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS, DENSITY IN G/CC. AND TEMPERATURE IN DEGREES KELVIN.

TABLE

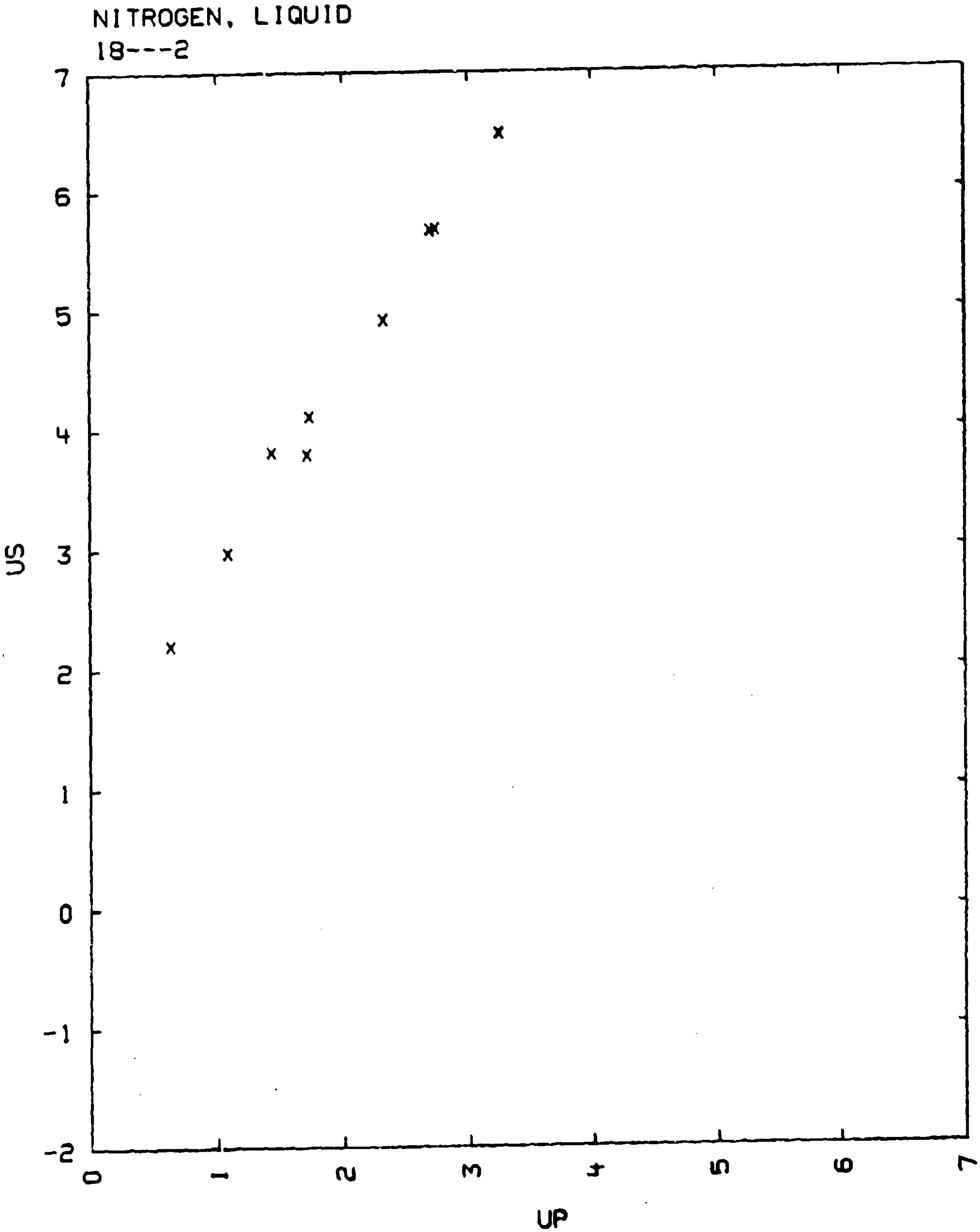
T0	RHO0	US	UP	P	V/V0
77	0.808	3.79	1.72	52.6	0.546
-	-	3.81	1.44	44.4	0.622
-	-	2.97	1.10	26.4	0.630
-	-	4.11	1.74	71.5	0.577
-	-	4.92	2.32	92.4	0.528
-	-	2.20	0.64	11.4	0.710
-	-	5.68	2.74	126.0	0.518
-	-	5.66	2.70	123.0	0.523
-	-	6.47	3.26	170.0	0.496

US = 1.219 + 1.622*UP KM/SEC.
SIGMA US = 0.13 KM/SEC.

COMMENTS:

1) SOURCE: DICK R. D. AND SCHOENHERR G.
PRIVATE COMMUNICATION
GMX-7 LOS ALAMOS SCIENTIFIC LABORATORY, LOS ALAMOS, N. M.
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE :
IN THESE EXPERIMENTS THE VELOCITY OF THE INTERFACE BETWEEN THE SAMPLE AND THE FLAT BOTTOM OF THE METAL CONTAINER WAS MADE DIRECTLY. A CORRECTION WAS MADE FOR THE EXPECTED MOTION OF THE PROBE. THE METHOD APPEARED TO YIELD RESULTS COMPARABLE TO THE MORE USUAL DATA REDUCTION METHOD B WITH AN UNCERTAINTY OF +OR- 3 PERCENT. MAX ERROR = 6 PERCENT.
3) THE INITIAL SOUND SPEED C0 WAS OBTAINED FROM: VAN ITTERBEEK A. AND VAN DAEL W., PHYSICA, VOL. 28, PAGE 861 (1962)

TABLE I



18---3
NITROGEN

N2 99. WT. PERCENT
O2 1. - -

TO = 75 DEG. K. CO = 0.88 KM/SEC.
VO = 1.220 CC/G.

THE TABLE LISTS DENSITY IN G/CC., VELOCITIES IN KM/SEC. AND PRESSURE IN KBAR. DUS AND DUP ARE THE UNCERTAINTIES IN US AND UP.

TABLE

- - - - - - - - - SAMPLE	- - - - - - - - - - - -						- STANDARD -	
RHOO	US	DUS	UP	DUP	P	V/VO	US(ST)	DUS(ST)
0.820	2.58	0.02	0.75	0.10	16.	0.708	6.07	0.07
0.820	2.97	0.02	0.97	0.05	24.	0.674	6.24	0.04
0.820	3.53	0.01	1.39	0.04	40.	0.606	6.58	0.03
0.820	4.19	0.02	1.85	0.03	63.	0.558	6.97	0.03
0.820	5.09	0.02	2.44	0.02	102.	0.521	7.48	0.02
0.820	5.50	0.02	2.69	0.02	121.	0.512	7.71	0.02
0.820	5.92	0.03	2.90	0.12	141.	0.510	7.91	0.01
0.820	6.66	0.03	3.54	0.07	193.	0.469	8.48	0.05
0.820	6.98	0.08	3.64	0.09	208.	0.479	8.58	0.07
0.820	7.34	0.04	3.98	0.08	239.	0.458	8.89	0.06
0.820	7.52	0.05	4.26	0.07	263.	0.434	9.13	0.06
0.820	7.59	0.03	4.32	0.12	269.	0.431	9.19	0.10
0.820	7.43	0.03	4.38	0.08	267.	0.410	9.22	0.06
0.820	7.73	0.03	4.50	0.10	285.	0.418	9.35	0.08
0.820	8.17	0.06	4.55	0.09	305.	0.443	9.43	0.07
0.820	7.92	0.05	4.60	0.11	299.	0.420	9.44	0.09
0.820	8.36	0.06	4.69	0.08	321.	0.440	9.56	0.06
0.820	8.51	0.08	4.86	0.05	339.	0.429	9.71	0.04
0.820	8.48	0.03	5.04	0.11	350.	0.406	9.85	0.09
0.820	8.82	0.04	5.20	0.10	376.	0.411	10.02	0.08
0.820	8.92	0.06	5.30	0.12	388.	0.406	10.11	0.10

US = A + B*UP, WITH A = 1.49 KM/SEC. B = 1.49
SIG.A = 0.06 KM/SEC. SIG.B = 0.02
FOR US BETWEEN 2.3 AND 7.4 KM/SEC.,
A =-1.0 KM/SEC. B = 2.0
SIG.A = 2.0 KM/SEC. SIG.B = 0.4
FOR US BETWEEN 7.4 AND 8.4 KM/SEC. AND
A = 4.06 KM/SEC B = 0.92
SIG.A = 0.05 KM/SEC. SIG.B = 0.01
FOR US BETWEEN 8.4 AND 9.0 KM/SEC.

COMMENTS:

1) SOURCE: DICK, R.D.
LOS ALAMOS SCIENTIFIC LAB. (THESIS)
LOS ALAMOS SCIENTIFIC LAB.,

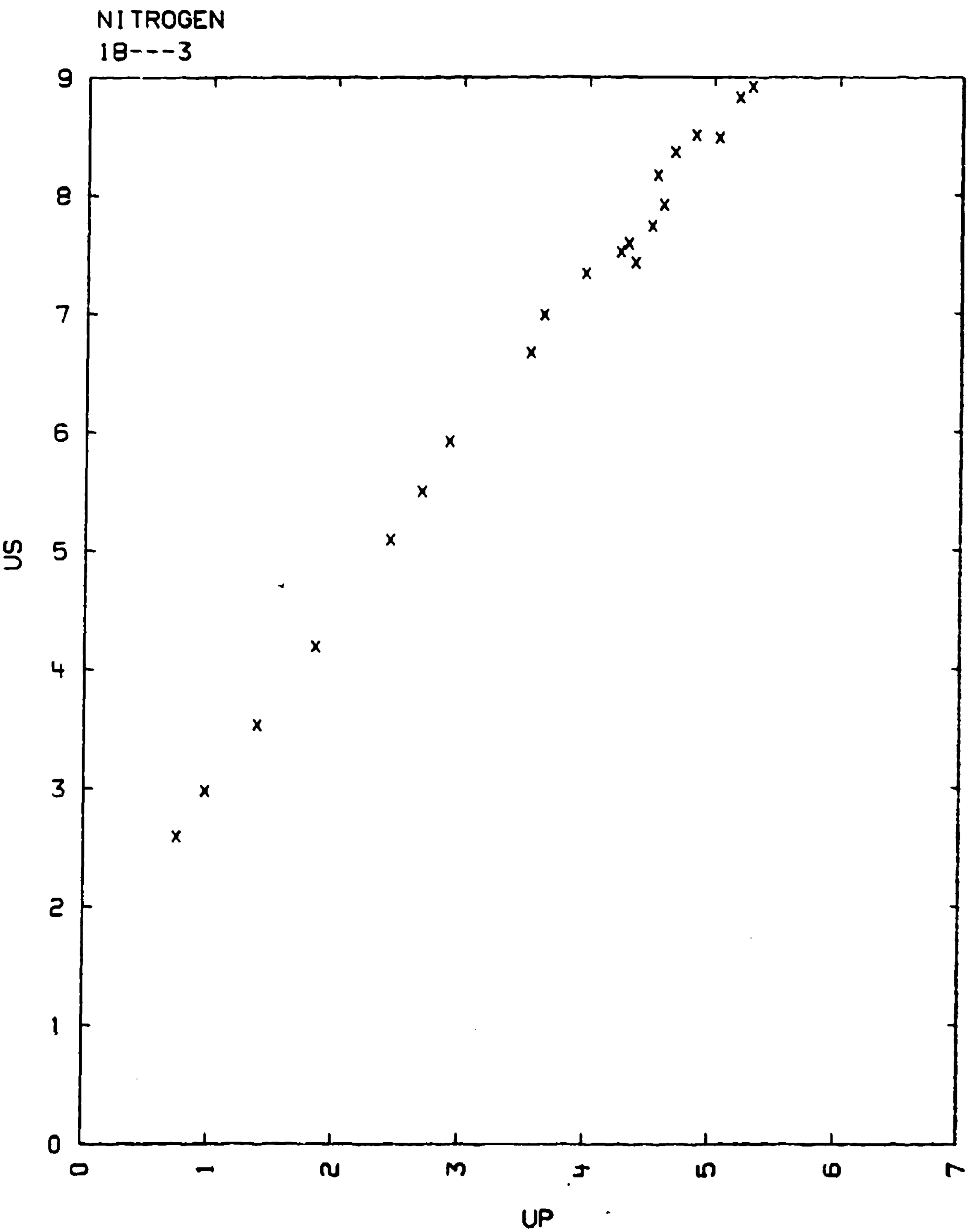
LOS ALAMOS, BOX 1663, NEW MEXICO 87544

2) EXPERIMENTAL TECHNIQUE: A

DATA REDUCTION METHOD: B   STANDARD MATERIAL 2024 AL ALLOY WITH
US = 5.460 + 1.318*UP RHOO = 2.785G/CC
AND GRUNEISEN GAMMA = 2.22

3) THE SOUND VELOCITY WAS TAKEN FROM: A. VAN ITTERBEEK AND W. VAN DAEL PHYSICA, VOL. 28, P. 861 (1962)

TABLE I



21---1
ANTIMONY

SB

VO = 0.1493 CC/G. CO= 2.37 KM/SEC.
VOI = 0.1485 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC

TABLE

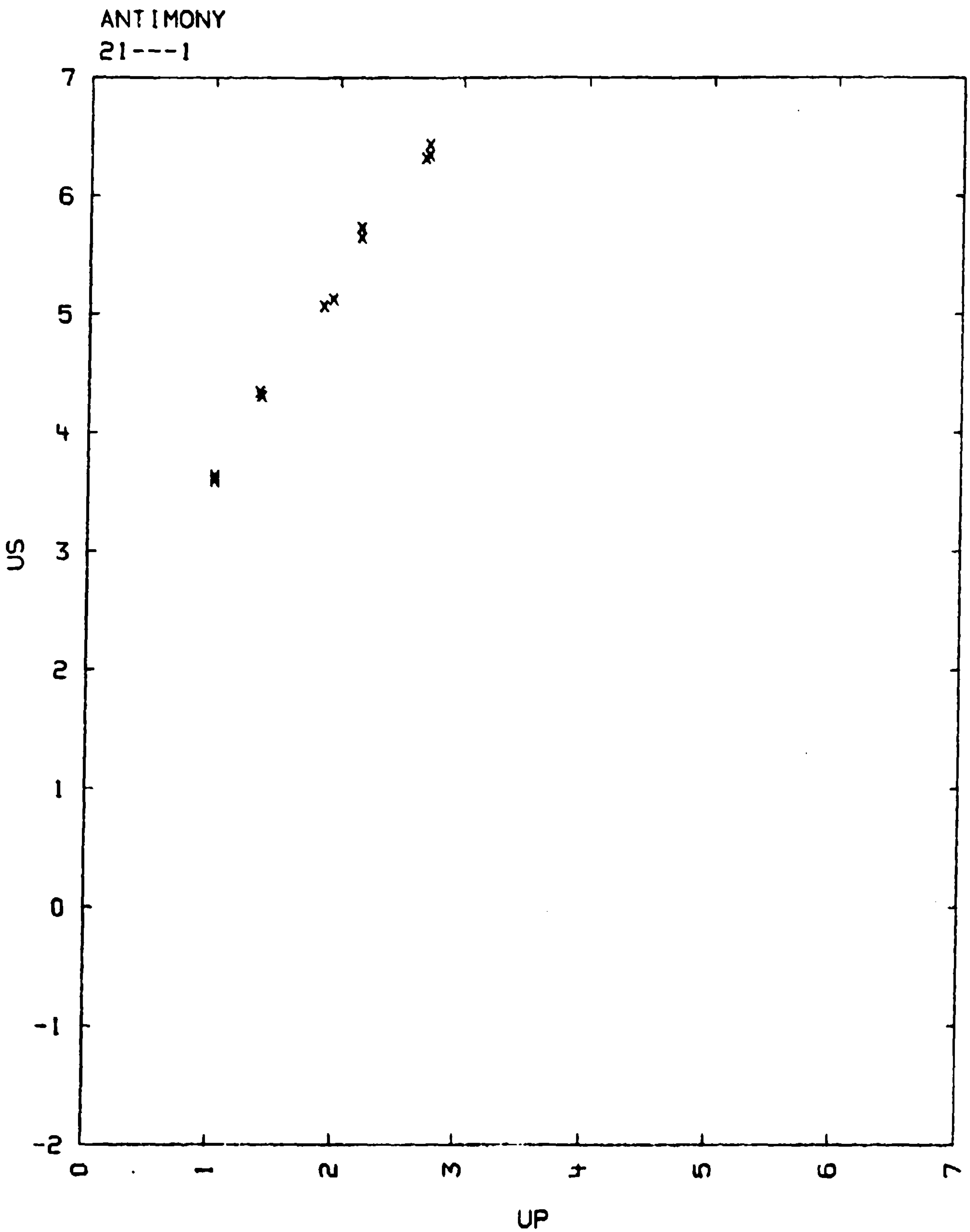
SAMPLE					STANDARD	
RHOO	US	UP	P	VIVO	P	MTRL
6.70	3.61	1.03	248	0.716	220	AL
-	3.59	1.03	248	0.713	220	-
-	3.63	1.02	249	0.720	220	-
-	4.30	1.39	400	0.678	339	-
-	4.33	1.38	401	0.681	339	-
-	5.12	1.96	673	0.617	869	BRASS
-	5.06	1.88	637	0.629	819	-
-	5.64	2.19	828	0.611	1040	-
-	5.72	2.19	838	0.618	1042	
-	5.71	2.20	843	0.614	1051	
-	6.31	2.70	1142	0.572	1422	
-	6.34	2.73	1158	0.569	1442	
-	6.43	2.73	1178	0.576	1452	

US = 1.989 + 1.634 UP SIGMA US = 0.2 PERCENT

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
J. APPL. PHYS., VOL. 31, P. 1253 (1960)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIALS: BRASS SEE MTRL. NO. 36--33
2024 ALUMINUM ALLOY SEE MTRL. NO. 29
3) CO CALCULATED FROM THE BULK MODULUS IN
C. KITTEL: INTRODUCTION TO SOLID STATE PHYSICS.
(JOHN WILEY AND SONS INC. N.Y.) 2ND ED. 1956
4) VOI OBTAINED FROM: AM. INST. OF PHYS. HANDBOOK (MCGRAW HILL-BOOK CO., N.Y., 1963) 2ND ED.
5) AN ESTIMATE OF THE GRUNEISEN GAMMA HAS BEEN MADE BY: D.B. SIRDESMUKH AND KAMASWARA RAO. J. APPLIED PHYSICS, V. 44, P. 894, (1973)

TABLE I



22---0
BISMUTH, SUMMARY

BI

VO = 0.1016-0.1021 CC/G   CL = 2.18 KM/SEC   CO = 1.771 KM/SEC
VOI = 0.10197 CC/G   CS = 1.10 KM/SEC   CB = 1.86 KM/SEC

THE TABLE LISTS POINTS CALCULATED FROM THE US VS. UP FITS GIVEN BELOW. DENSITY IS IN G/CC, VELOCITIES IN KM/SEC. PRESSURE IN KBAR AND E-EO IS INTERNAL ENERGY CHANGE IN KBAR CC/G. TP = TRANSITION POINT.

TABLE I

FIT	RHOO	US	UP	P	V/VO	E-EO	COMMENTS		
	9.807	2.30	0.009	2.0	0.9962	0.00040	1ST	WAVE	
1	-	1.79	0.009	2.0	0.9962	0.00040	2ND	-	
1	-	1.86	.040	7.6	0.9795	0.00520	-	-	
1	-	1.95	.080	15.5	0.9597	0.0256	-	-	
1	-	2.05	0.126	25.5	0.9391	0.0688	-	-	TP
2	-	1.755	0.30	55.0	0.8388	0.220	3RD	-	
2	-	2.183	0.50	107.	0.771	1.205	2ND	-	
2	-	2.718	0.75	200.	0.724	2.81	1ST	-	
2	-	3.253	1.00	319.	0.693	5.00	-	-	
3	-	3.66	1.2	431.	0.672	7.20	-	-	
3	-	4.73	2.0	928.	0.577	20.0	-	-	
3	-	6.07	3.0	1787	0.506	45.0	-	-	
3	-	7.41	4.0	2908	0.460	80.0	-	-	
3	-	8.08	4.5	3567	0.443	101.2	-	-	

US = 1.771 + 2.21*UP +OR- 0.02 KM/SEC FIT 1
FOR UP BETWEEN .009 AND .126 KM/SEC.
US = 1.113 + 2.14*UP, SIG.US = .03 KM/SEC FIT 2
FOR UP BETWEEN .3 AND 1.1 KM/SEC.
US = 2.05 + 1.341*UP, SIG.US = 0.07 KM/SEC FIT 3
- FOR UP BETWEEN 1.1 AND 4.5 KM/SEC.

TABLE II LISTS CORRECTED DATA FOR THE TRANSITION WAVE OF 22---6. P IN KBARS, AND V/VO ARE CALCULATED ASSUMING A 2 KBAR ELASTIC WAVE WITH PARTICLE VELOCITY = 0.009 KM/SEC.

TABLE II

RHOO	TO	T	US	UP	P	V/VO
9.804	19	40	2.050	0.126	25.5	0.9391
9.813	-48	-29	2.088	0.143	29.4	0.9828

BISMUTH, SUMMARY

RHOO	TO	T	US	UP	P	V/VO
9.804	62	85	2.033	0.118	23.7	0.9425
9.813	208	233	1.990	0.086	17.0	0.9584

US =

COMMENTS:

1) SOURCE: COMPILER
2) THE DATA OF 22---1,2,3,4,6,7 WERE USED IN THIS SUMMARY.
3) THE FIRST WAVE PRESSURE OF CAST BISMUTH FROM 22---7 IS GIVEN HERE. THE MAXIMUM PRESSURE OF THIS RAMP-SHAPED PRECURSOR WAS USED WITH ITS AVERAGE VELOCITY TO CALCULATE V/VO AND UP FOR THE FIRST WAVE USING A SINGLE STEP APPROXIMATION.
THIS SUMMARY SHOULD NOT BE EXPECTED TO YIELD AN ACCURATE DESCRIPTION OF THIS HIGHLY ANISOTROPIC MATERIAL NEAR THE 2 KBAR REGION.
4) FIT 1: THE TRANSITION PRESSURE OF 22---7 WAS COMBINED WITH THE US VALUE OF 22---6 TO GIVE A STRAIGHT US-UP L [illegible] TO THE INTERCEPT CO,O.
5) THE ADOPTION OF THE 22---7 PHASE POINT CORR[illegible] THE UP1 VALUES OF 22---6 BY 6.6 PERCENT TO THOSE OF TABLE [illegible]
6) THE SECOND SHOCK PARAMETERS OF 22---6 HAVE [illegible]N USED IN THE 2ND FIT.
7) A NUMBER OF GRUNEISEN GAMMAS HAVE BEEN ESTI[illegible] FOR THIS- AND OTHER V,VI ELEMENTS: D.B. SIRDESHMUKH AND B. KAMA[illegible] AO J. APPL. PHYS. [illegible], P. 894 (1973)

TABLE I

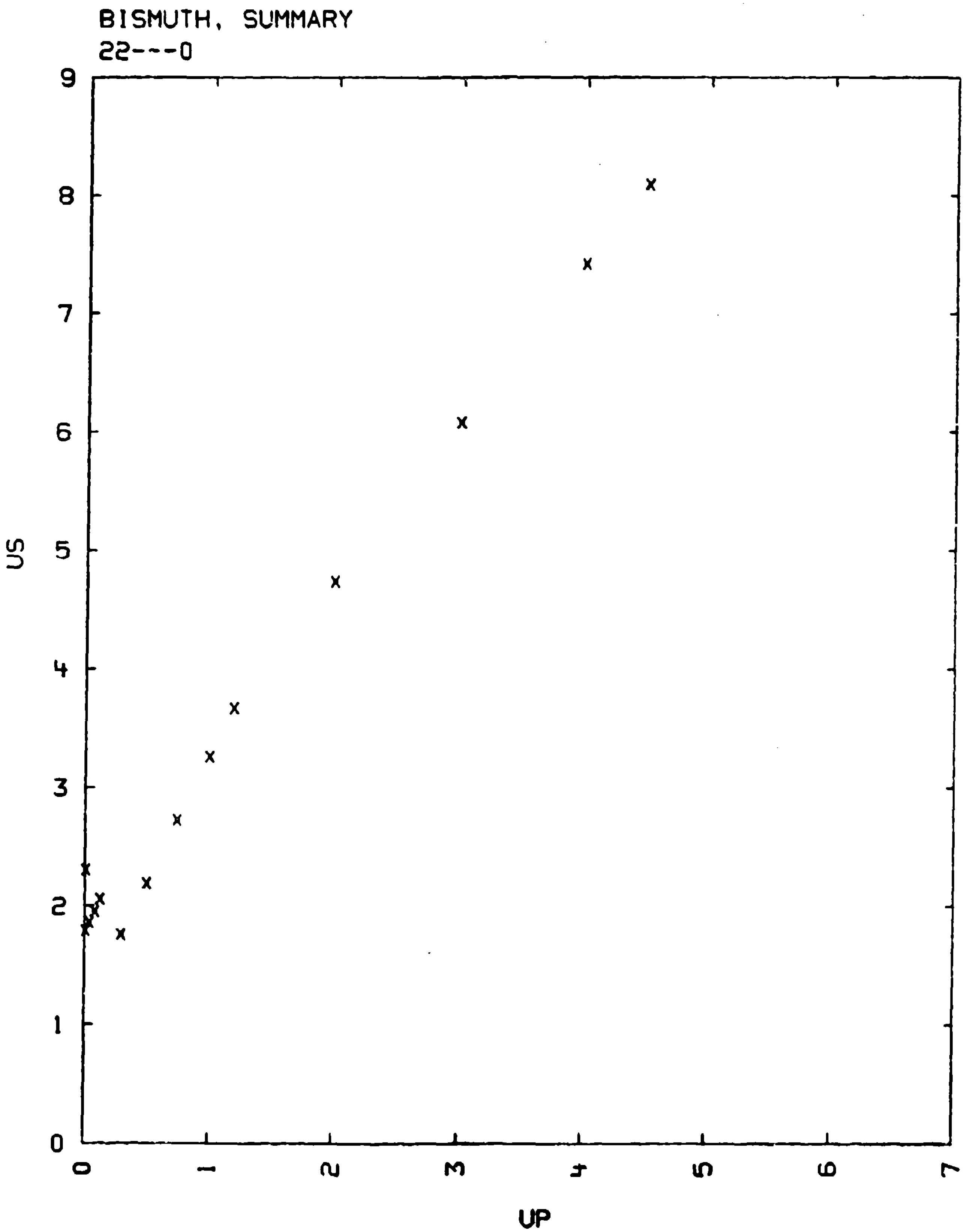
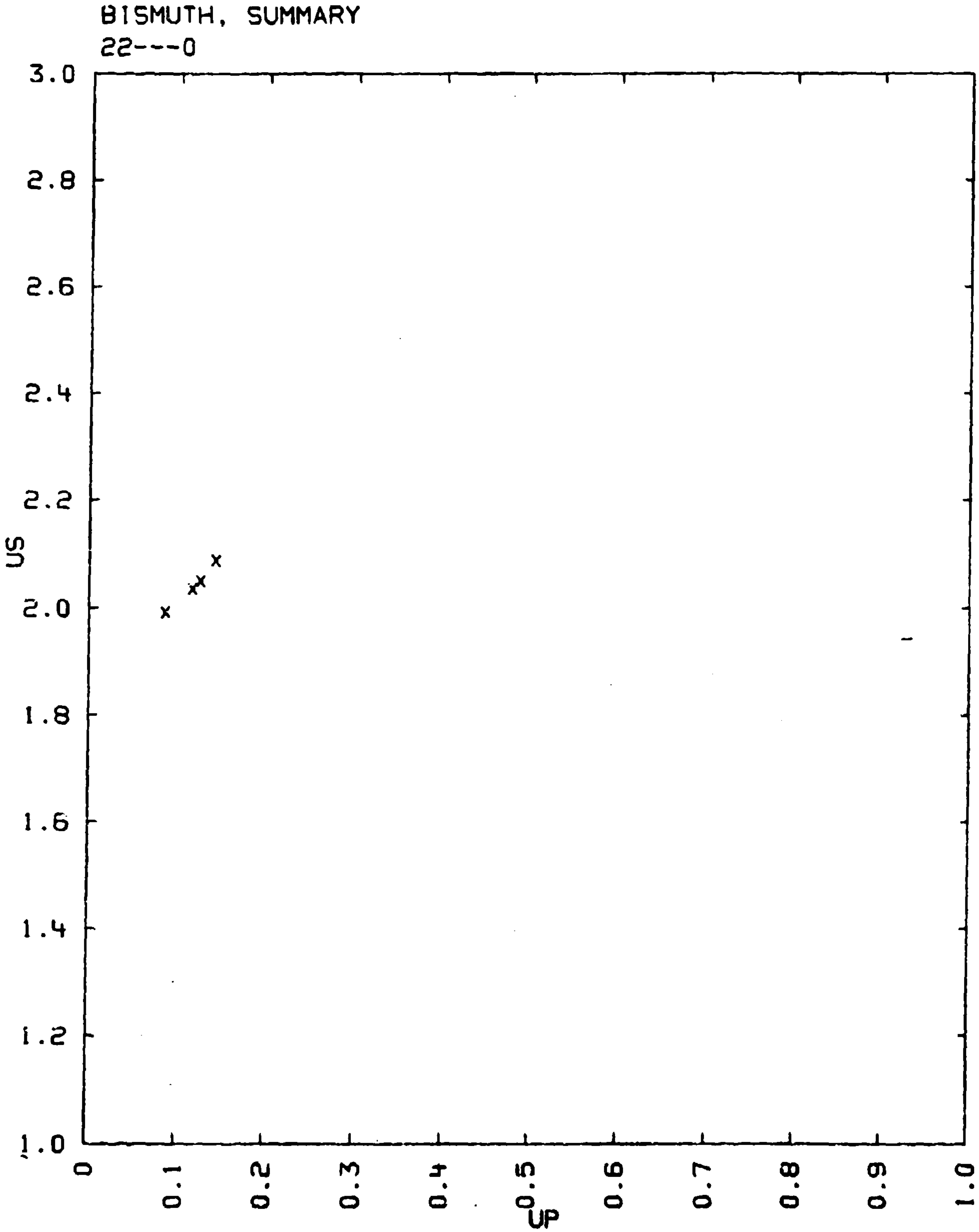


TABLE II


BISMUTH, SUMMARY
22---0
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
US
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP

22---1
BISMUTH

BI 99.8 PER CENT OR GREATER

VO = 0.1021 CC/G   CL = 2.18 KM/SEC.   CO = 1.77 KM/SEC.
VOI = 0.1014 CC/G   CS = 1.10 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC.
PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

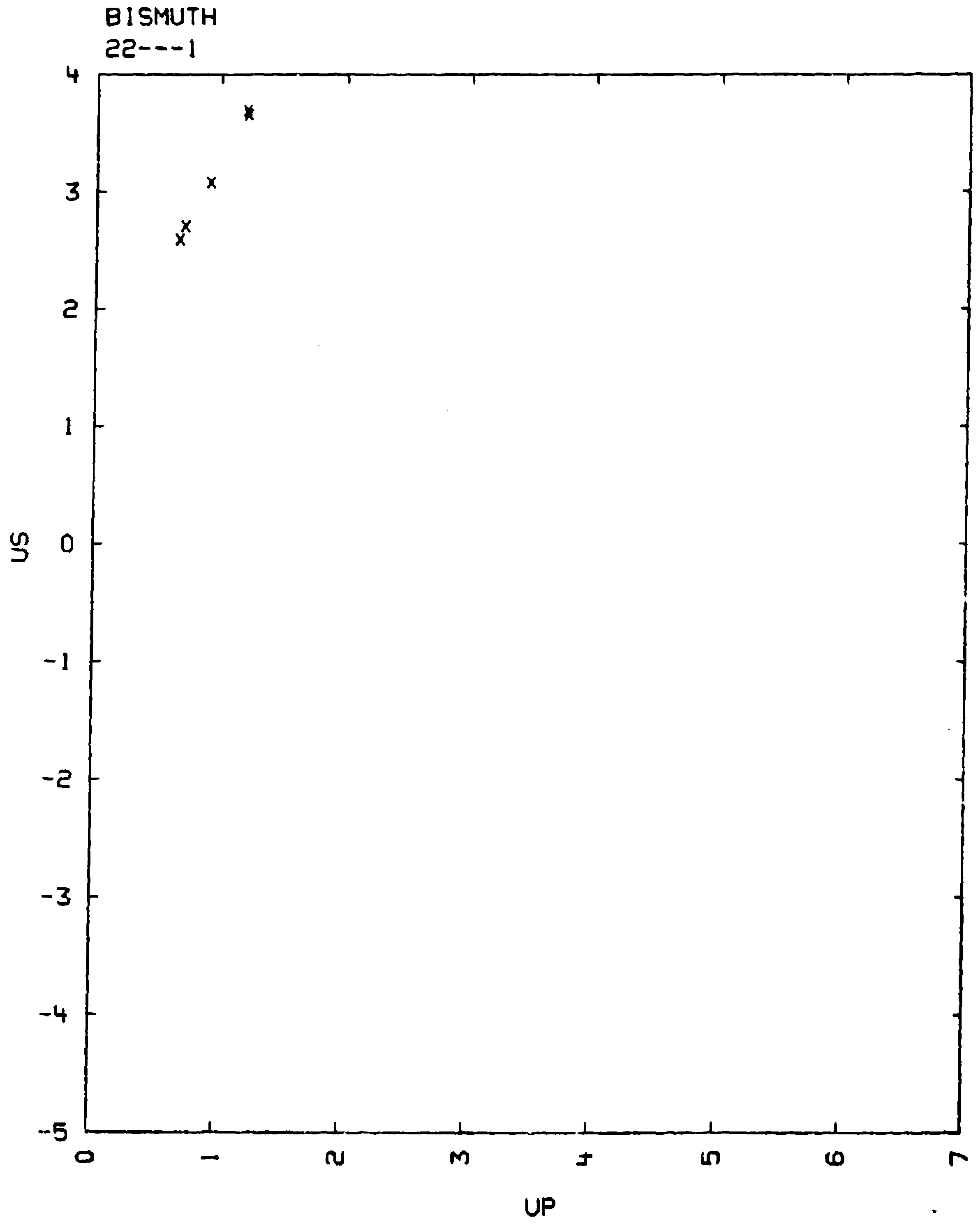
RHOO	US	UFS	UP	P	V/VO
9.79	2.696	1.401	0.718	189.5	0.7337
-	2.585	1.318	0.676	171.1	0.7385
-	3.075	1.793	0.914	275.2	0.7028
-	3.084	1.800	0.922	278.4	0.7010
-	3.682	2.476	1.212	436.9	0.6708
-	3.659	2.564	1.222	437.7	0.6660

US = 1.259 + 1.982 UP KM/SEC   SIGMA US = 0.6 PERCENT

COMMENTS:

1) SOURCE: WALSH, J.M., RICE, M.H., MCQUEEN, R.G. AND YARGER, F.L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS
4) CL AND CS VALUES WERE OBTAINED FROM L. BERGMAN, DER ULTRASCHALL,
S. HIRZEL VERLAG, STUTTGART, 1954, 6TH ED., P. 650
5) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY
FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 1 PER CENT IN
COMPRESSION AT A GIVEN PRESSURE.

TABLE I



22---2
BISMUTH

BI

V0 = 0.1015 CC/G. CO = 1.771 KM/SEC.
V01 = 0.1020 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURES IN KILOBARS AND DENSITY IN G/CC.

TABLE

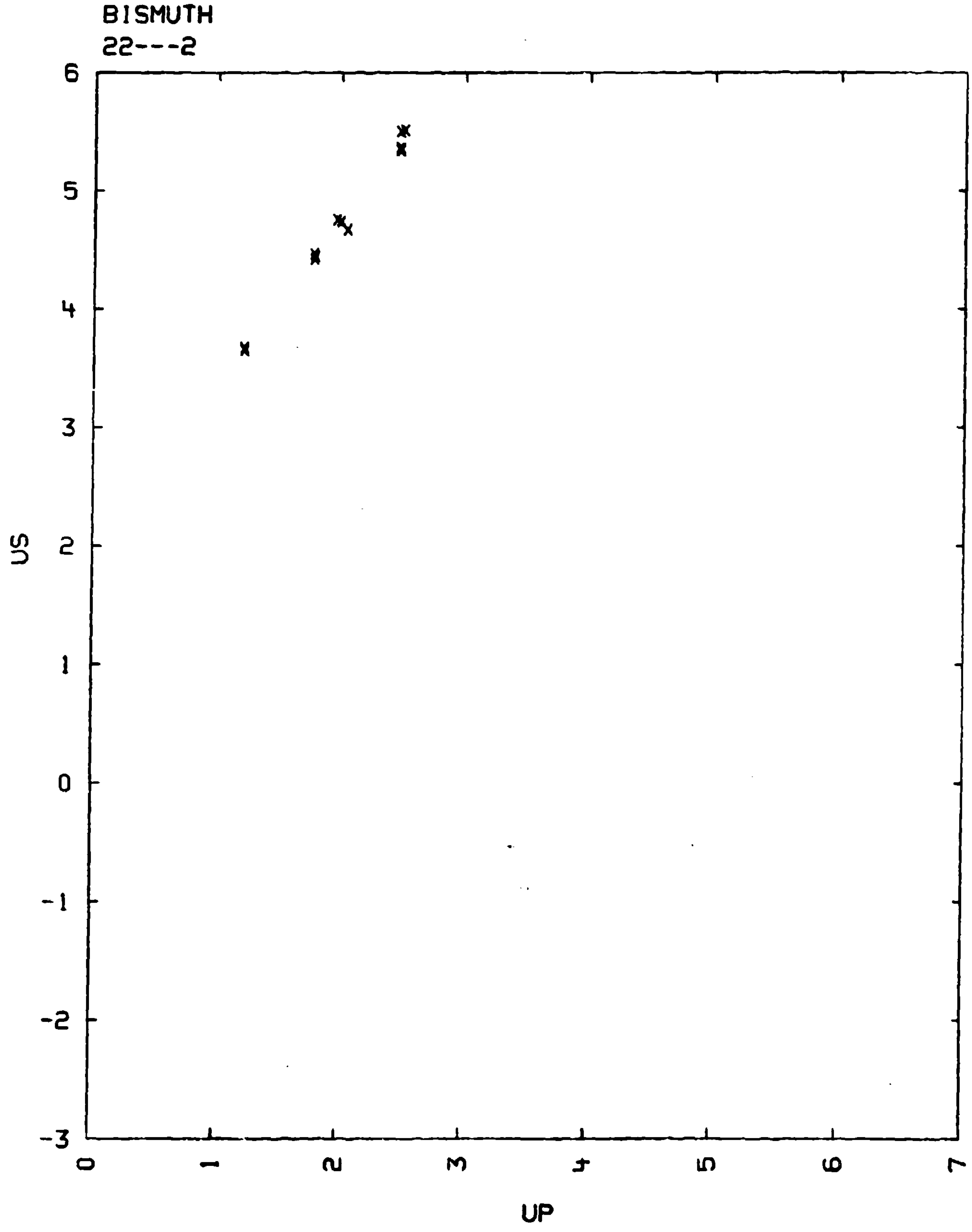
RHOO	US	UP	P	V/VO	PRESSURE IN BRASS STANDARD
9.85	3.67	1.23	444	0.665	339
-	3.64	1.23	443	0.661	339
-	4.44	1.80	786	0.596	882
-	4.42	1.79	781	0.594	867
-	4.46	1.79	787	0.599	869
-	4.75	1.97	923	0.585	1008
-	4.66	2.06	945	0.558	1050
-	4.73	2.00	931	0.577	1020
-	5.33	2.47	1299	0.536	1410
-	5.36	2.47	1303	0.540	1410
-	5.51	2.51	1360	0.545	1453
-	5.49	2.48	1344	0.548	1436
-	5.49	2.47	1335	0.551	1423

US = 1.88 + 1.42 UP KM/SEC. SIG.US = 0.07 KM/SEC.

COMMENTS:

1) SOURCE: MCQUEEN, R G. AND MARSH, S.P.
J. APPL. PHYS., VOL. 31, P. 1253 (1960)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS PRASS
3) FOR THE BRASS STANDARD DATA SEE MATERIAL 36--33---2
4) CO IS OBTAINED FROM DR. LUDWIG BERGMANN, DER ULTRASCHALL,2N ED., (S. HIRZEL VERLAG STUTTGART, GERMANY, 1954)

TABLE I



22---3
BISMUTH

BI

VO 0.102 CC/G
VOI = 0.1020 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN KM/SEC AND PRESSURE IN KILOBARS.

TABLE

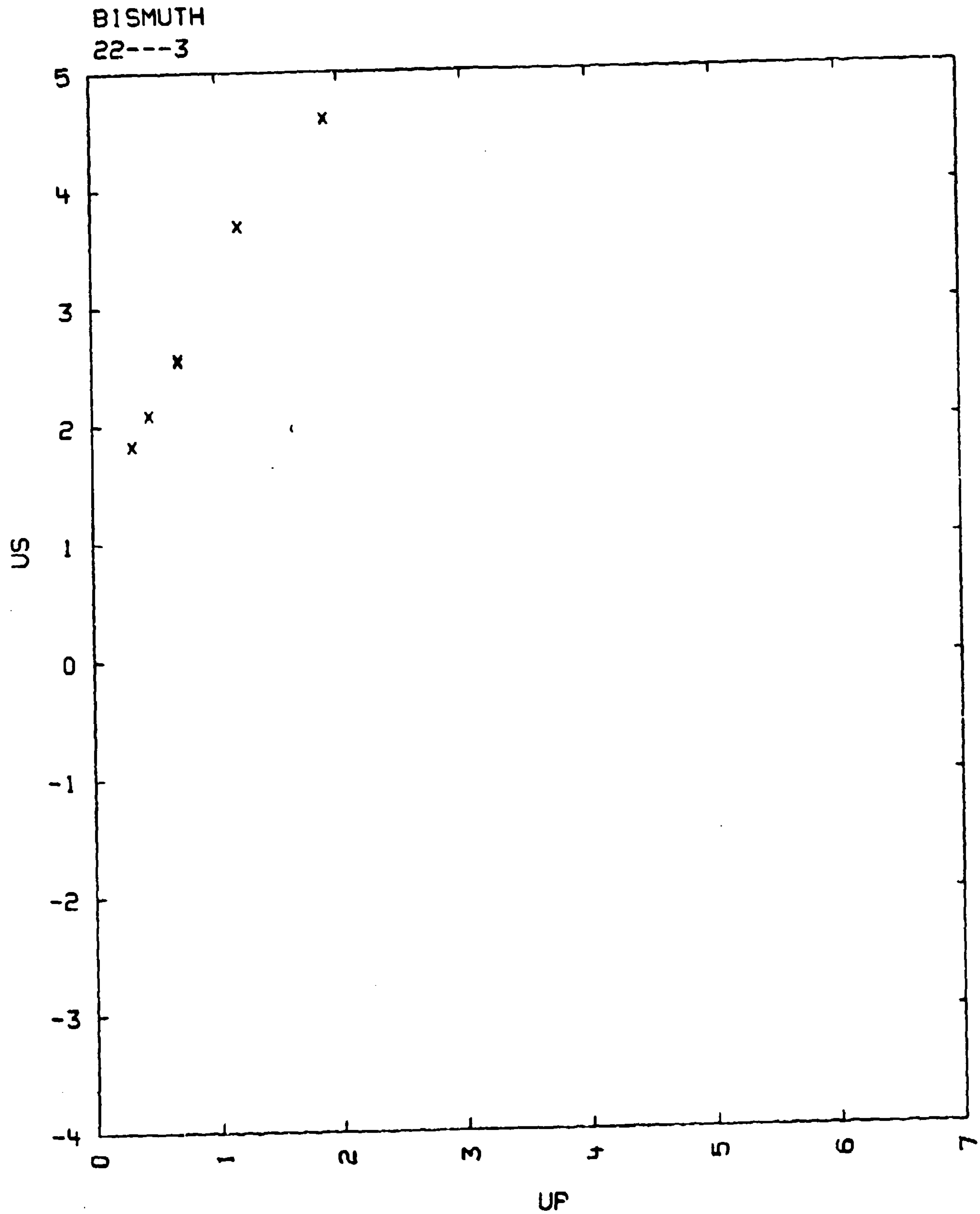
SAMPLE						BASE PLATE	
RHOO	US	UFS	UP	P	V/VO	MATERIAL	PRESSURE
9.772	3.69	2.50	1.19	428	0.678	AL	324
9.775	2.56	1.29	0.69	173	0.730	AL	146
9.781	2.54	1.34	0.69	173	0.727	AL	146
9.79	4.60	4.07	1.90	855	0.587	AL	618
9.77	2.08	0.89	0.46	94	0.778	BRASS	133
9.767	1.82	0.72	0.32	74	0.870	BRASS	95

US = 1.58 + 1.61 UP KM/SEC
SIGMA US = 0.246 KM/SEC

COMMENTS:

1) SOURCE: COMPILER
L.R.L. EQUATION OF STATE FILE
LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIFORNIA.
2) EXPERIMENTAL TECHNIQUE B. STANDARD MATERIALS: 2024 AL ALLOY
ASTM B16 BRASS
DATA REDUCTION TECHNIQUE B.
3) THE VALUE OF VOI WAS OBTAINED FROM A. TAYLOR AND BRENDA J. KAGLE, CRYSTALLOGRAPHIC DATA ON METAL AND ALLOY STRUCTURES (DOVER PUBLICATIONS, INC., NEW YORK, N. Y., 1963).

TABLE I



22---4
BISMUTH

BI

V0 = 0.1020 G/CC.
V01 =0.1020 G/CC.   CB = 1.86 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

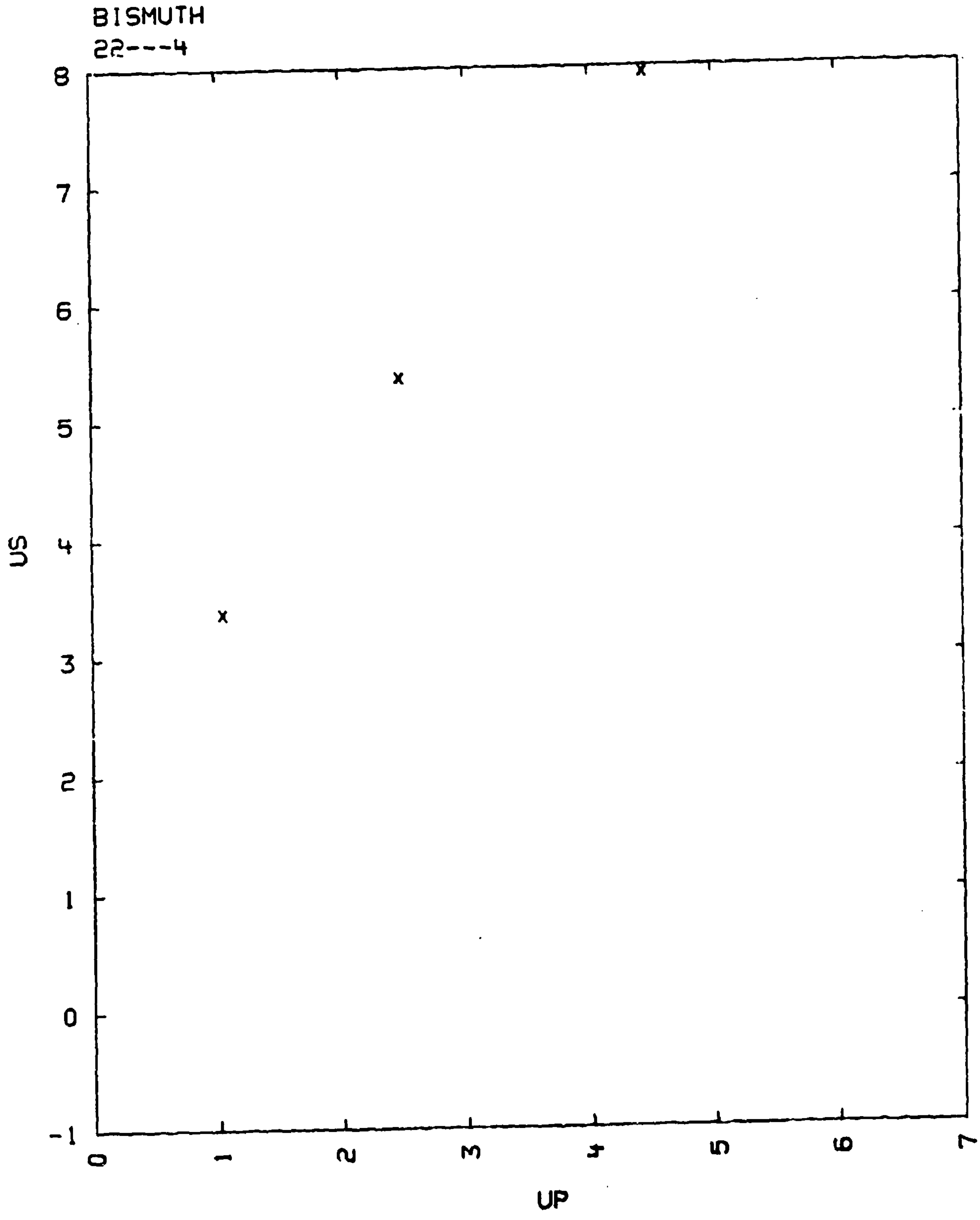
RHOO	US	UP	P	V/V0
9.80	3.37	1.05	350	0.690
	5.36	2.47	1300	0.538
	7.94	4.45	3450	0.439

US = 2.00 + 1.34UP KM/SEC.

COMMENTS:

1) SOURCE: AL'TSHULER, L. V., KRUPNIKOV, K. K. AND BRAZHNIK, M. I.
   SOVIET PHYS.-JETP, VOL. 34, P. 614 (1958)
2) EXPERIMENTAL TECHNIQUE A
   DATA REDUCTION TECHNIQUE B
   STANDARD MATERIAL FE
3) CB IS CALCULATED USING THE VOLUME COMPRESSION COEFFICIENT TAKEN FROM P. W. BRIDGMAN, THE PHYSICS OF HIGH PRESSURE (G. BELL AND SONS LTD. LONDON 1958)
4) V01 WAS OBTAINED FROM THE HANDBOOK OF CHEMISTRY AND PHYSICS (THE CHEMICAL RUBBER PUBLISHING CO. 1962-1963) 44TH ED.
5) THE SPECIMEN WITH A THICKNESS BETWEEN 6-8MM. WAS ATTACHED TO A IRON PLATE OF COMPARABLE THICKNESS 6-9MM.

TABLE I



22---5
BISMUTH

BI

V0 = 0.1016-0.1020 G/CC
V01 = 0.1014 G/CC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

SAMPLE					STANDARD
RHO0	US	UP	P	V/V0	UFS
9.80	3.511	1.139	392	0.676	2.980
-	3.521	1.130	390	0.679	2.970
9.84	3.558	1.105	387	0.689	2.920
-	3.568	1.105	388	0.690	2.920
9.84	3.411	1.044	350.5	0.694	2.720
-	3.376	1.096	364	0.675	2.820
9.82	3.451	1.045	354	0.697	2.730
-	3.425	1.048	352.5	0.694	2.730
9.84	3.385	1.025	339	0.697	2.260
-	3.376	1.030	342	0.695	2.270
9.82	3.259	1.044	334	0.680	2.660
-	3.268	0.989	317.5	0.697	2.540
9.83	3.305	0.957	311	0.710	2.490
-	3.222	0.998	316	0.690	2.550
9.82	3.221	0.980	310	0.695	2.505
-	3.276	0.970	312	0.704	2.500
9.82	3.119	0.997	306.5	0.680	2.510
-	3.149	0.999	309	0.682	2.520
9.83	3.180	0.968	302.5	0.696	2.460
-	3.213	0.987	303	0.699	2.480
9.82	3.033	0.866	258	0.714	2.185
-	3.033	0.873	260	0.712	2.200
9.82	2.919	0.830	238	0.716	2.070
-	2.957	0.836	242.5	0.717	2.095
9.83	2.763	0.696	189	0.748	1.715
-	2.663	0.703	184	0.736	1.710
9.84	2.392	0.588	138.5	0.754	1.385
-	2.438	0.582	139.5	0.761	1.375
9.82	2.224	0.615	135	0.723	1.390
-	2.265	0.600	134	0.735	1.370
9.83	2.303	0.537	121.5	0.767	1.245
-	2.283	0.530	119	0.768	1.225
9.81	2.271	0.532	118.5	0.766	1.220
-	2.271	0.530	118	0.767	1.215
9.82	2.170	0.554	118	0.745	1.245
-	2.185	0.556	119	0.746	1.250
9.83	2.104	0.455	94	0.784	1.015
-	2.102	0.463	95.5	0.780	1.030
-	2.091	0.465	95.5	0.778	1.027
-	2.088	0.463	95	0.778	1.025

BISMUTH

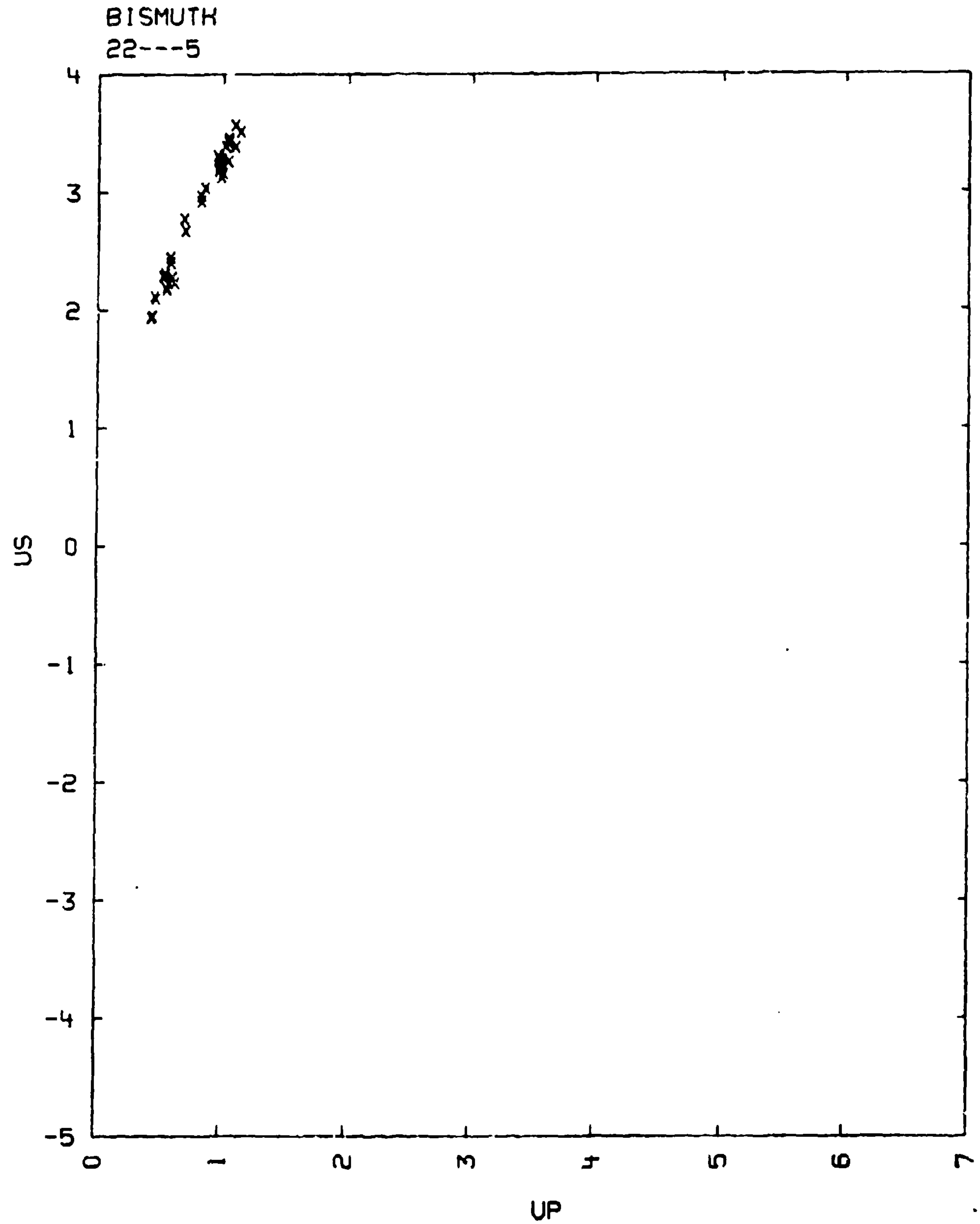
RHOO	US	UP	P	V/VO	UFS
-	1.938	0.430	82	0.778	0.925
-	1.925	0.423	80	0.780	0.900

US = 1.050 + 2.224 UP KM/SEC.

COMMENTS:

1) SOURCE: BERGER J. AND FAUQUIGNON C.
PRIVATE COMMUNICATION (1964), B.P. NO. 7, SEVRAN, FRANCE
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION B
STANDARD MATERIAL AU4G
3) SAMPLE DIMENSIONS WERE: 2.0 CM DIAMETER
0.5 CM THICKNESS
4) VOI WAS CALCULATED FROM THE CONSTANTS, A = 4.53674 AND C = 11.83834
ANGSTROMS, OF THE HEXAGONAL UNIT CELL.
AMERICAN INST. OF PHYS. HANDBOOK (MCGRAW-HILL BOOK CO. 1963) 2ND ED.

TABLE I



22---6
BISMUTH

BI

VO = 0.1020-0.1021 CC/G   CL = 2.15 KM/SEC.
VOI = 0.1020 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURES IN KILOBARS, DENSITY IN G/CC AND TEMPERATURE IN DEGREES CENTIGRADE. THE NUMBERS 1 AND 2 DESIGNATE THE FIRST AND SECOND SHOCK WAVES.

TABLE

RHOO	TO	T1	US1	UP1	P1	V1/VO	US2	UP2	P2	V2/VO
9.794	19	42	2.043	0.136	27.2	0.9328	1.308	0.239	39.9	0.8508
9.804	19	42	2.041	0.135	27.0	0.9346	1.262	0.217	36.7	0.8666
9.804	19	42	2.048	0.134	26.9	0.9349	1.232	0.199	34.5	0.8787
9.804	19	42	2.063	0.136	27.5	0.9344	1.203	0.183	42.8	0.8933
9.813	-48	-27	2.088	0.153	31.3	0.9246				
9.804	62	87	2.033	0.127	25.3	0.9388				
9.813	208	236	1.990	0.092	17.6	0.9617				

US =

COMMENTS:

1) SOURCE: DUFF, R. E. AND MINSHALL, F. S.
PHYS. REV., VOL. 108, P. 1207 (1957)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE D, THE ASSUMPTION 2UP = UFS WAS USED.
3) VOI WAS OBTAINED FROM THE CRYSTAL DATA DETERMINATIVE TABLES, AMERICAN CRYSTALLOGRAPHIC ASSOCIATION, 2ED. (1963)

TABLE I

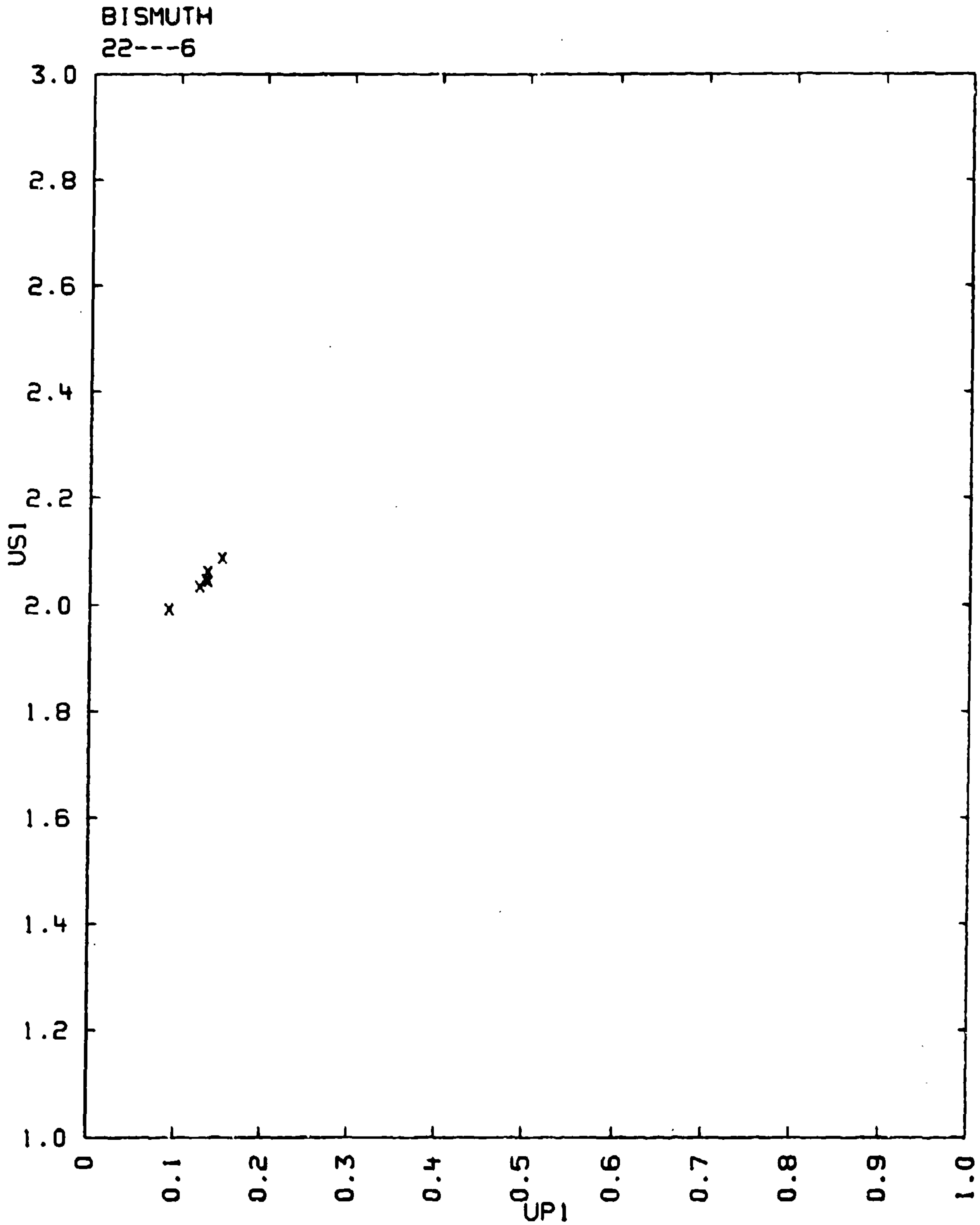
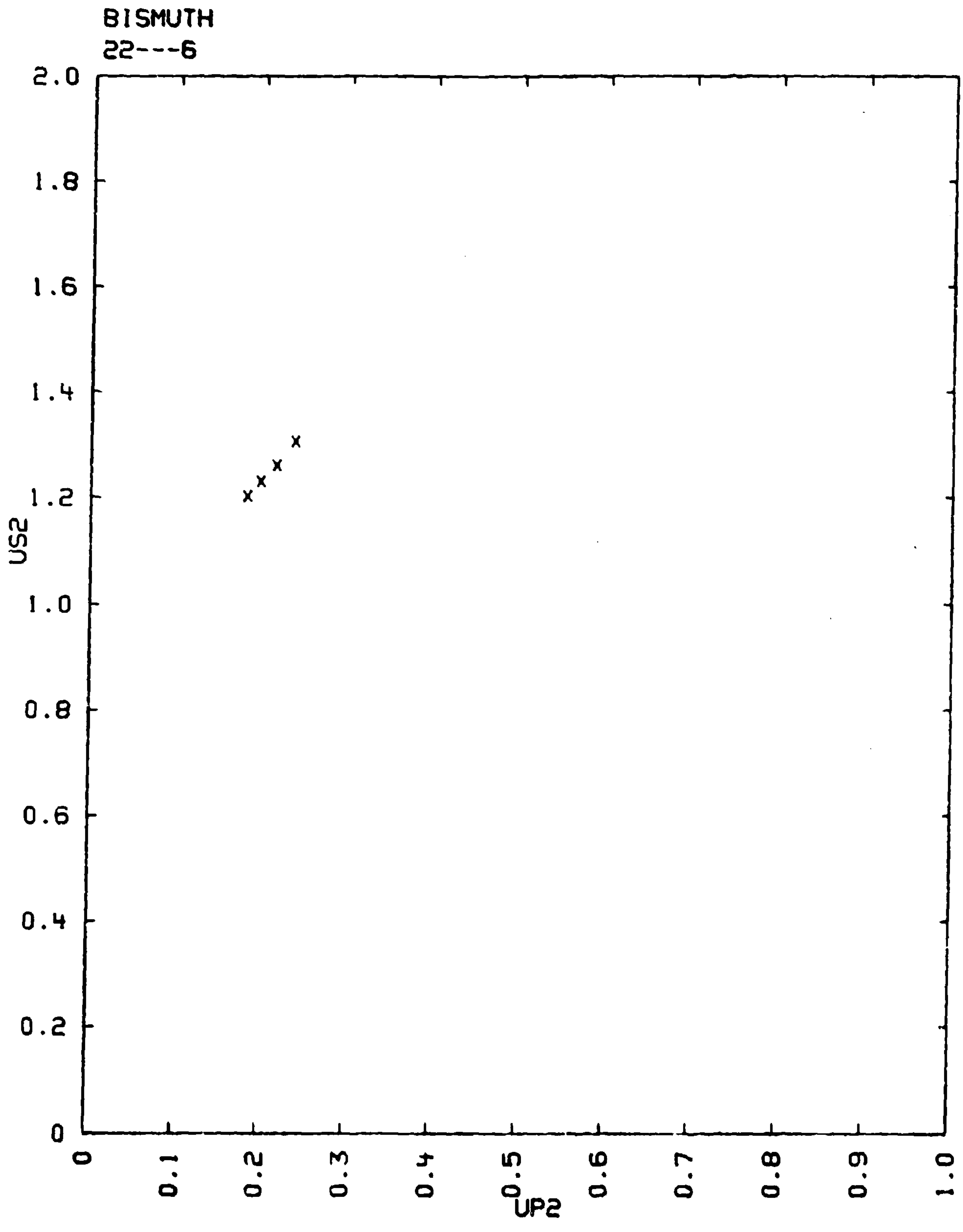

BISMUTH
22---6
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
US1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP1

TABLE I


BISMUTH
22---6
US2
UP2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

22---7
BISMUTH

BI

VOI = 0.101968 CC/G

CAST
VO = 0.1020 CC/G

PRESSED
VO = 0.1025 CC/G   CL = 2.27 KM/SEC   CO = 1.86 KM/SEC
CS = 1.13 KM/SEC

SINGLE CRYSTAL A AXIS
VO = 0.1020 CC/G   CL = 2.54 KM/SEC

SINGLE CRYSTAL C AXIS
VO = 0.1020 CC/G   CL = 1.98 KM/SEC
CS = 1.02 KM/SEC

IN THE TABLES BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE I
(CAST BISMUTH)

RHOO	US1	UP1	P1	V1/V0	US2	UP2	P2	V2/V0
9.804	2.30	0.0089	2.0	0.9961	2.06	0.126	25.5	0.939
-	-	0.0093	2.1	0.9960	2.06	0.130	26.5	0.937
-	-	0.0075	1.7	0.9967	2.06	0.126	25.6	0.939
-	-	0.0098	2.2	0.9958	2.06	0.122	24.6	0.941

US =

TABLE II
(PRESSED BISMUTH)

RHOO	US1	UP1	P1	V1/V0	US2	UP2	P2	V2/V0
9.756	2.16	0.0119	2.5	0.9945	2.06	0.126	25.4	0.939
-	-	0.0114	2.4	0.9947	2.06	0.124	25.1	0.940
-	-	0.0100	2.1	0.9954	2.06	0.131	26.5	0.937

US =

TABLE III

(SINGLE CRYSTAL BISMUTH A-AXIS)

RHOO	US1	UP1	P1	V1/VO	US2	UP2	P2	V2/VO
9.804	2.54	0.0104	2.6	0.9959	2.06	0.119	24.6	0.943

US =

TABLE IV
(SINGLE CRYSTAL BISMUTH C-AXIS)

RHOO	US1	UP1	P1	V1/VO	US2	UP2	P2	V2/VO
9.804					2.06	0.127	25.6	0.938
-	1.97	0.0161	3.1	0.9918	1.83	0.067	12.2	0.964

US =

COMMENTS:

1) SOURCE: LARSON, D. B.
J. APPL. PHYS. (1967), IN PRINT
UCRL-14853
UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY,
LIVERMORE, CALIFORNIA, 94550
2) EXPERIMENTAL TECHNIQUE I
DATA REDUCTION TECHNIQUE C.
3) THE TRANSITION REPORTED IN THIS PAPER IS UNDOUBTEDLY THE BI I TO BI II TRANSFORMATION OBSERVED STATICALLY BY B. W. BRIDGMAN, PHYS. REV. VOL. 48, P.896 (1935) AND DYNAMICALLY BY R. E. DUFF AND F. S. MINSHALL, PHYS. REV. VOL. 108, P.1207 (1957).
4) THE VALUE OF VO1 WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF A HEXAGONAL UNIT CELL CONTAINING SIX ATOMS
A = 4.54590 ANGSTROMS, C = 11.86225 ANGSTROMS (25 DEG. C.)
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SYDNEY, 1963) 2ND EDITION, VOL. 1, P. 32.
5) THE VALUE OF US1 IS THE AVERAGE VELOCITY OF A PRESSURE RAMP WITH LEADING EDGE TRAVELING AT 2.54 KM/SEC FOR CAST BISMUTH AND 2.27 KM/SEC FOR PRESSED BISMUTH. THE SINGLE CRYSTAL SAMPLES HAVE WELL-DEFINED ELASTIC SHOCK WAVES.

TABLE I

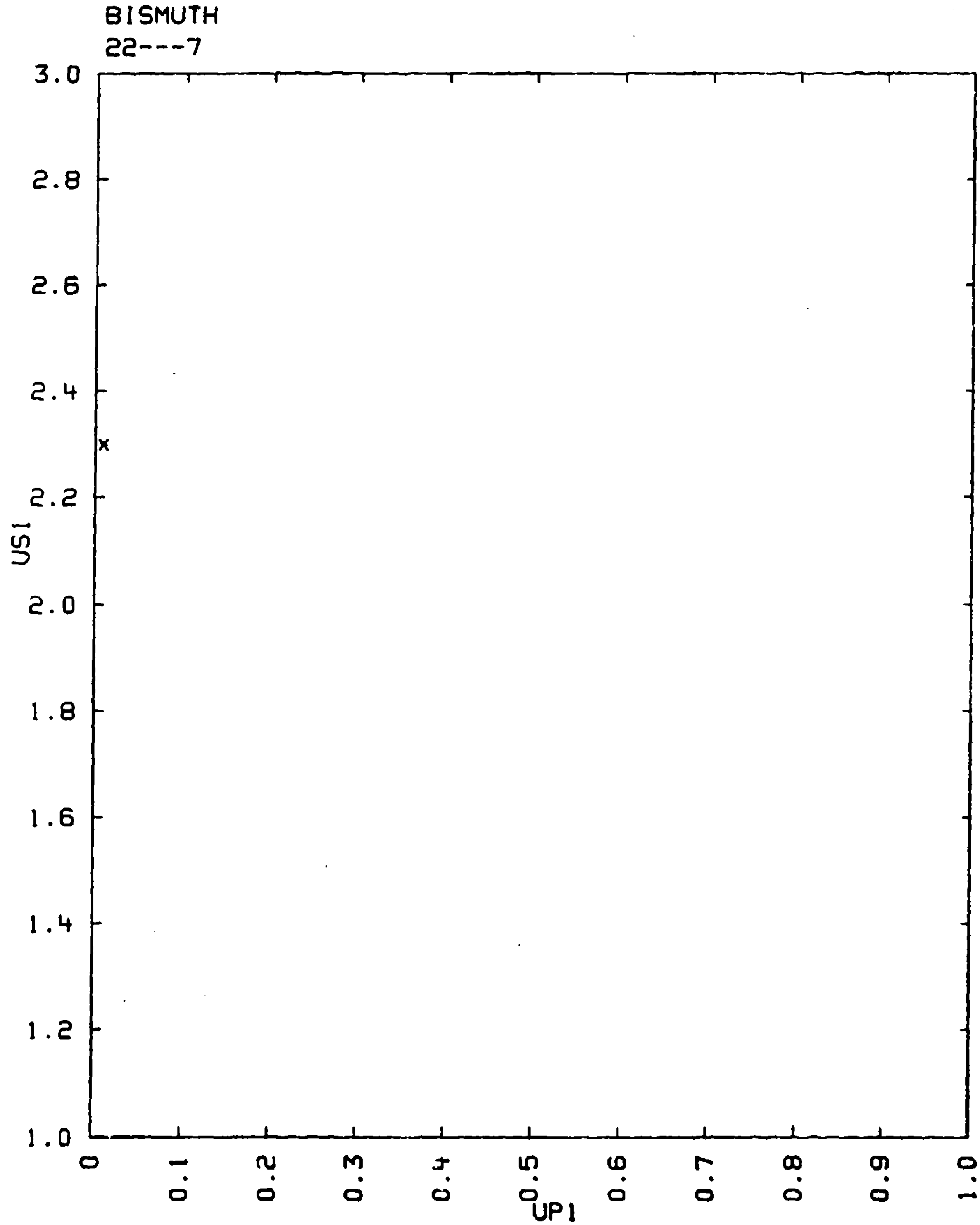
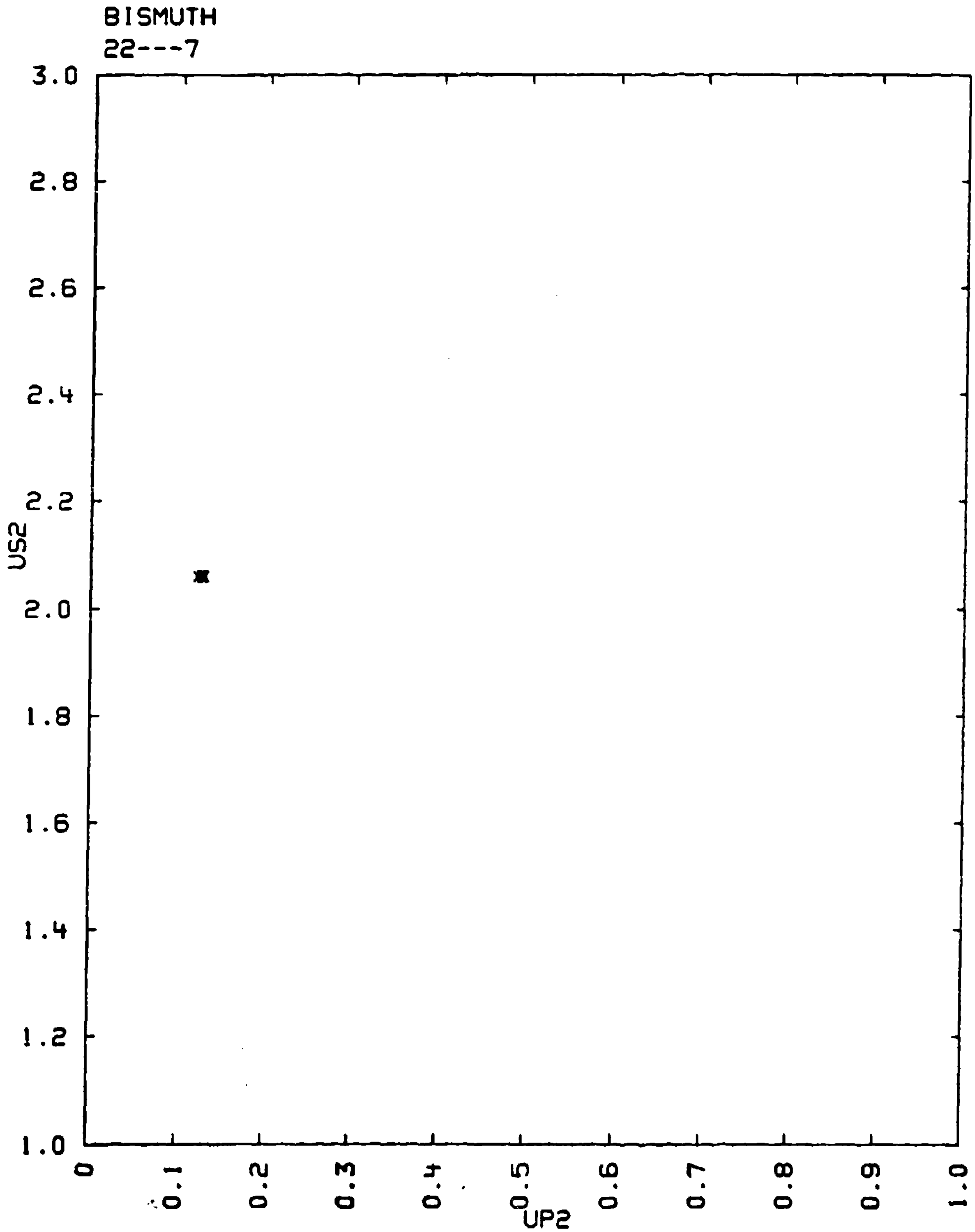
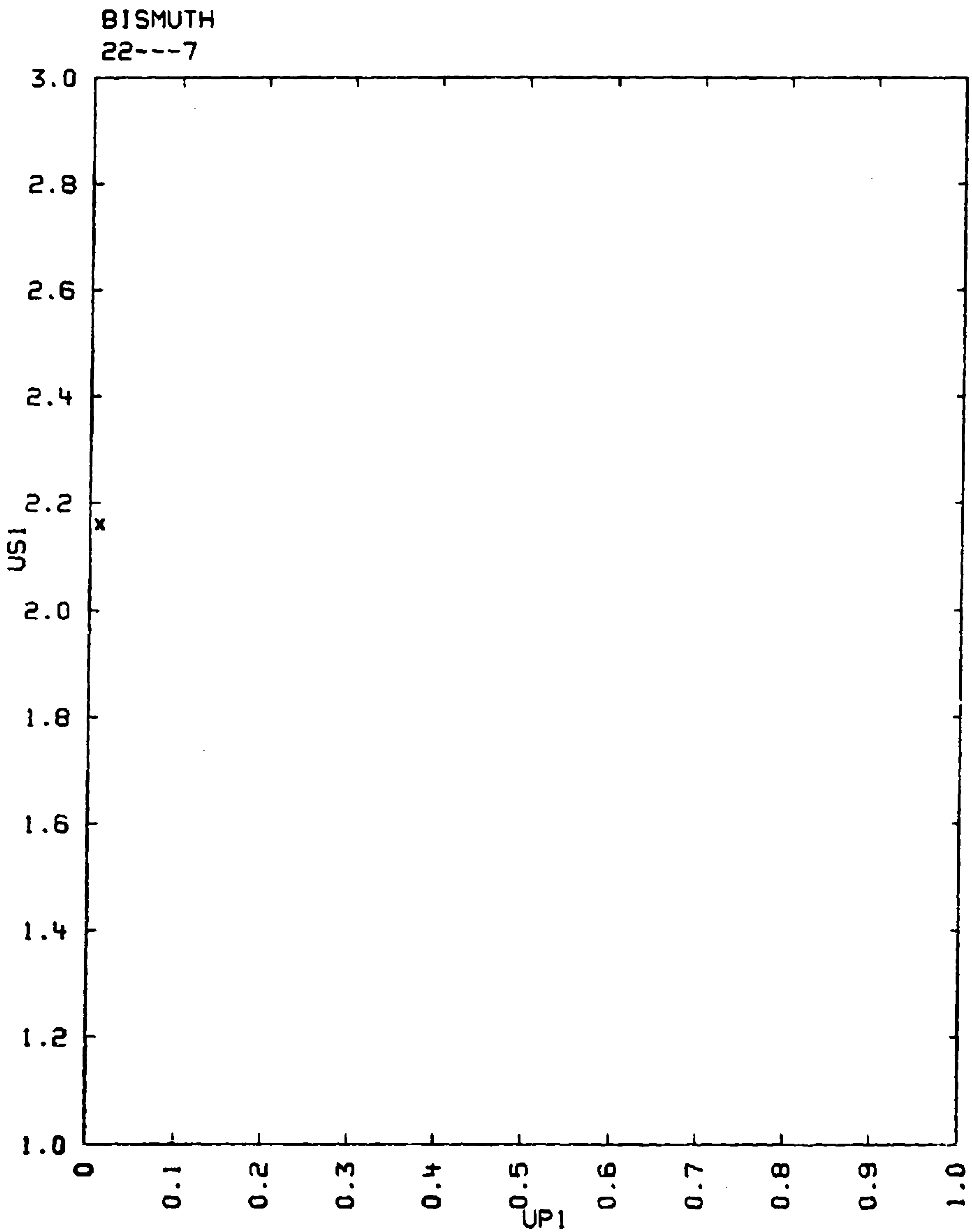

BISMUTH
22---7
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
US1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP1

TABLE I



BISMUTH
22---7
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
US2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP2

TABLE II



BISMUTH
22---7
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
US1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP1

TABLE II

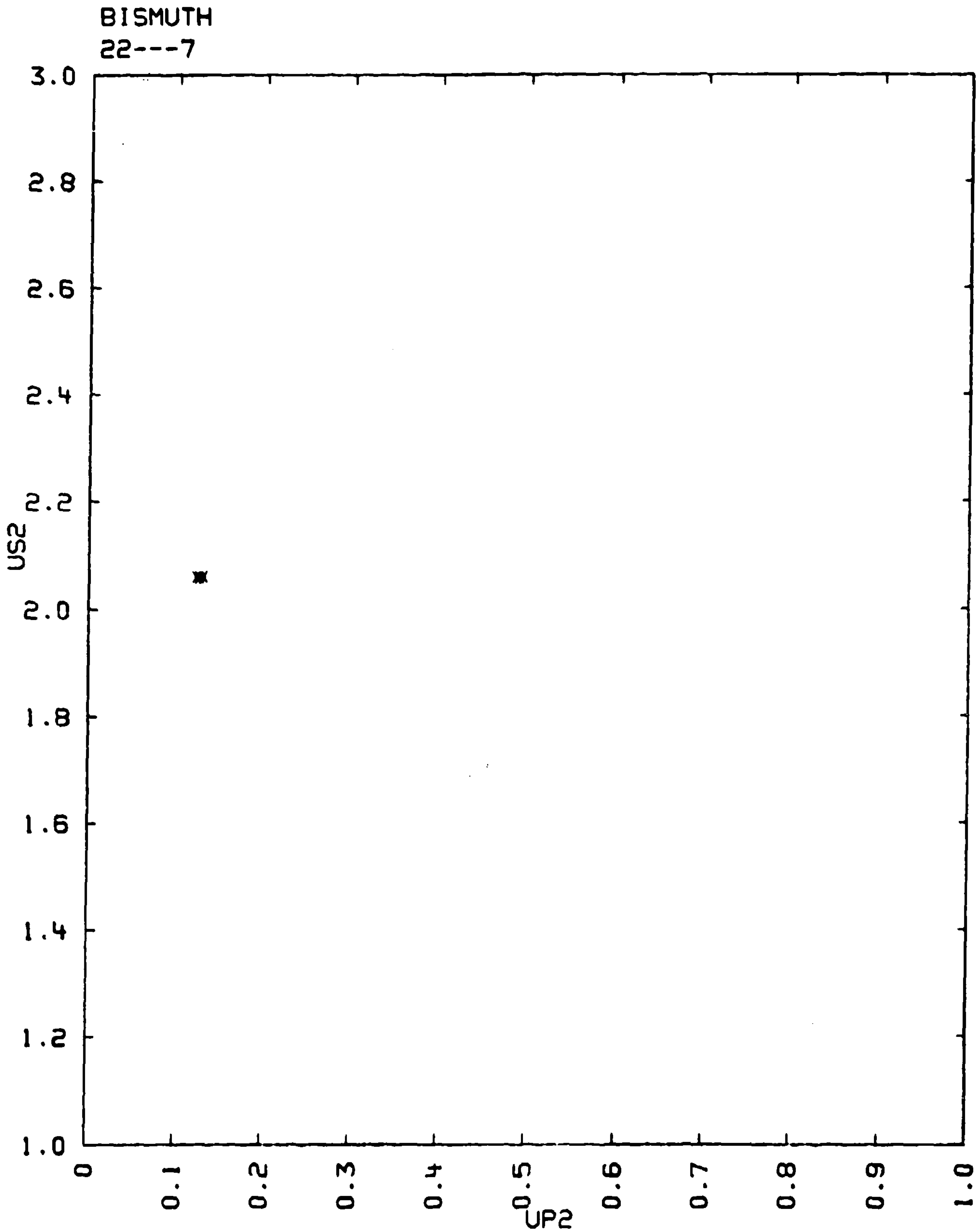

BISMUTH
22---7
US2
UP2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

TABLE III

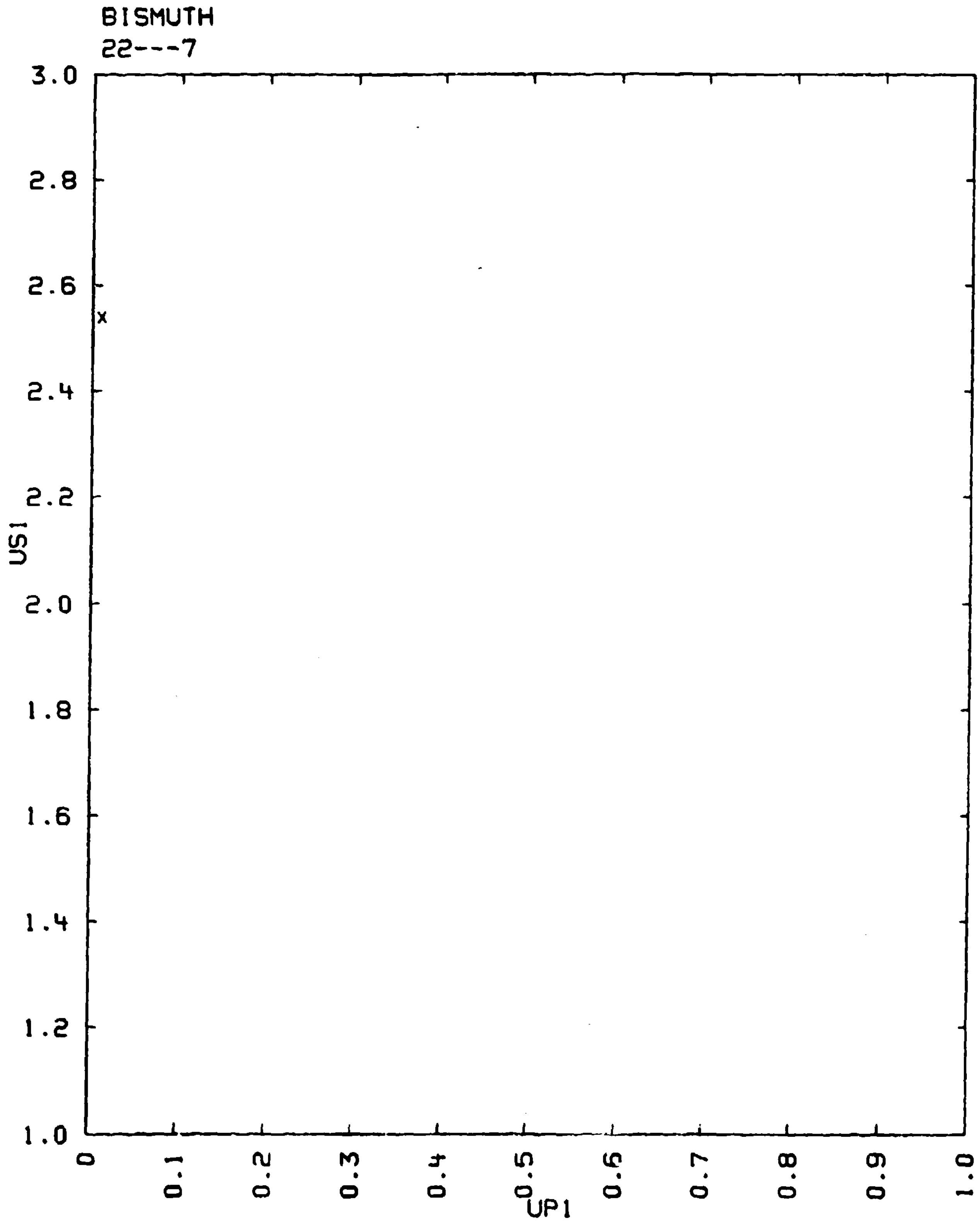

BISMUTH
22---7
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
US1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP1

TABLE III

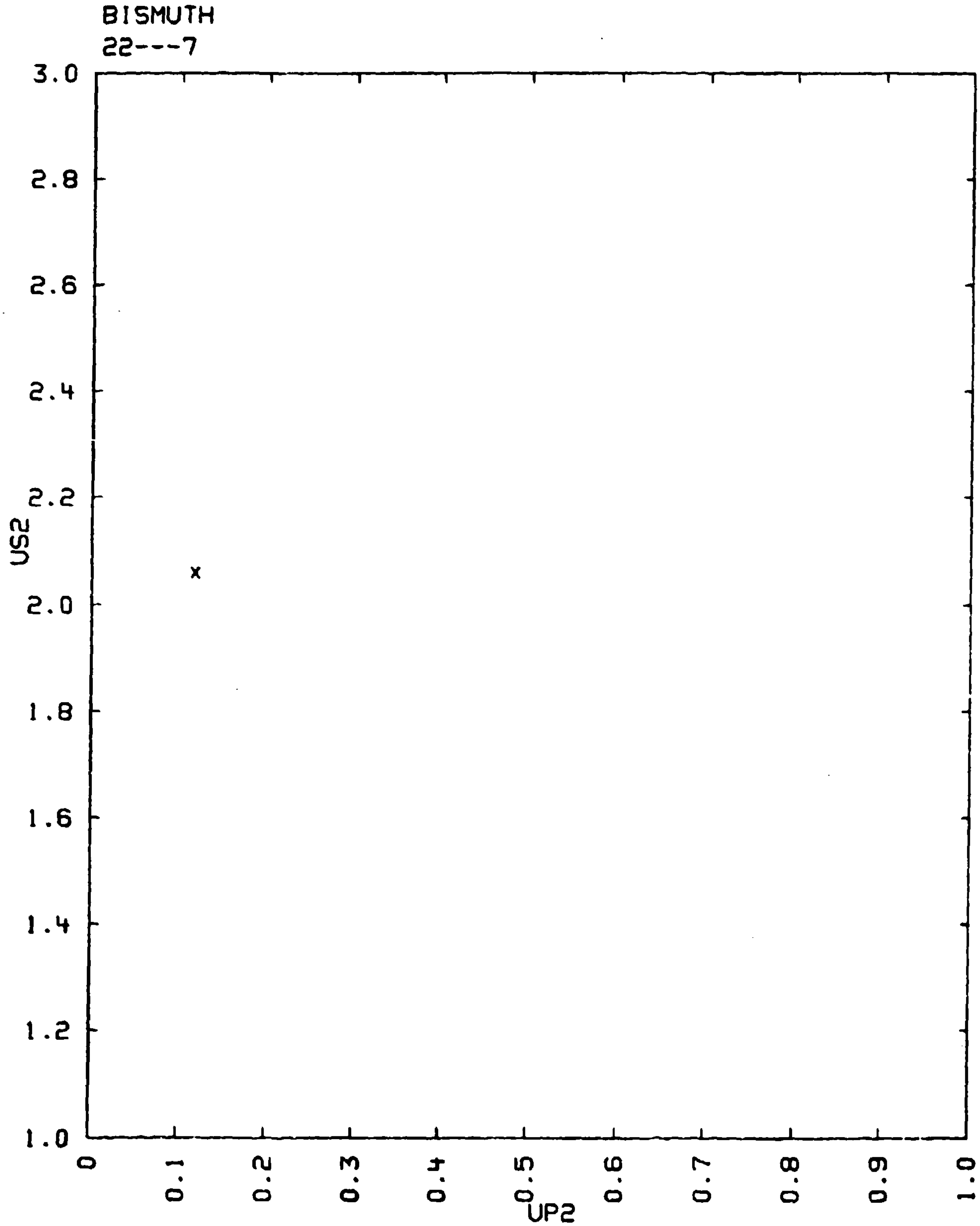
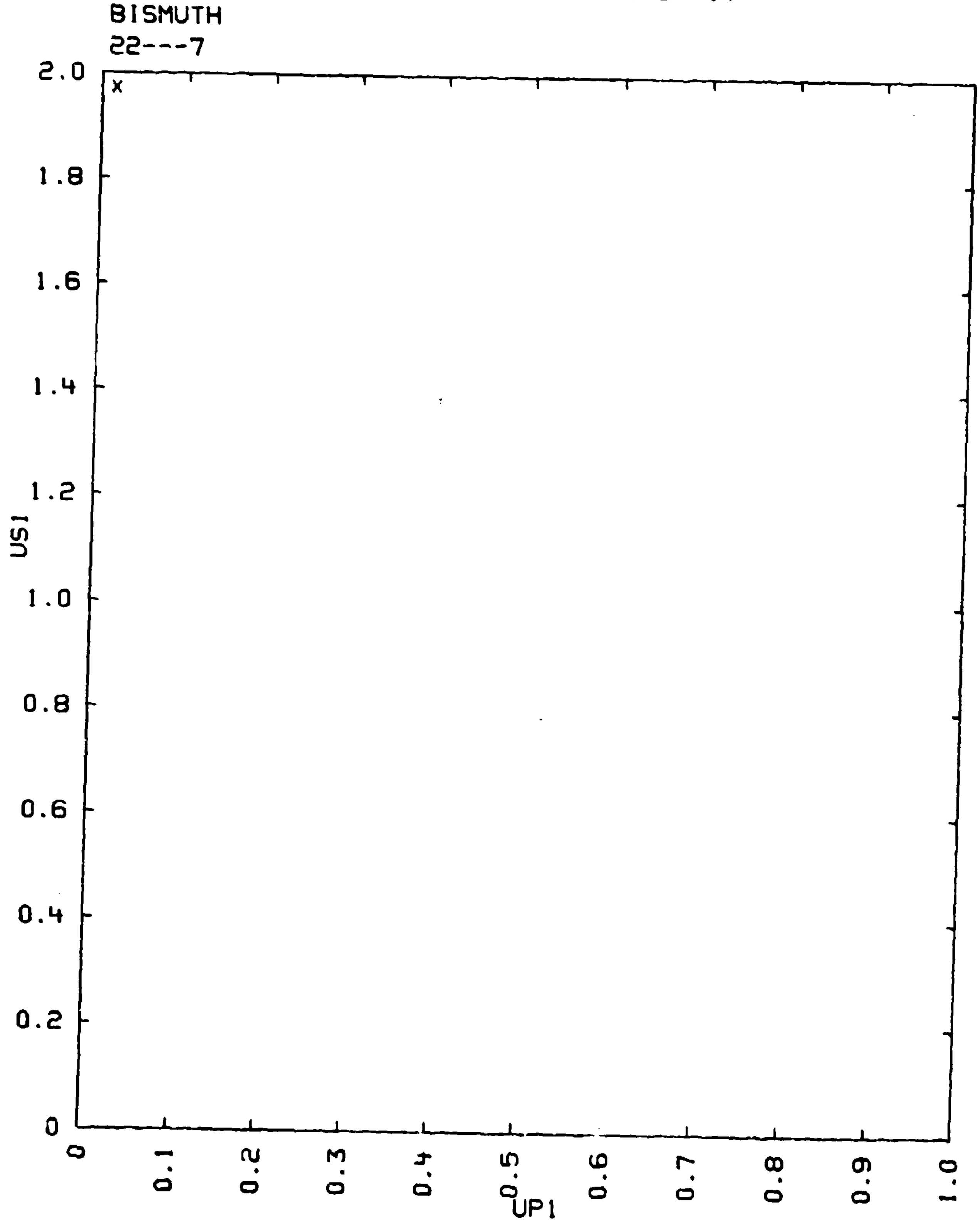
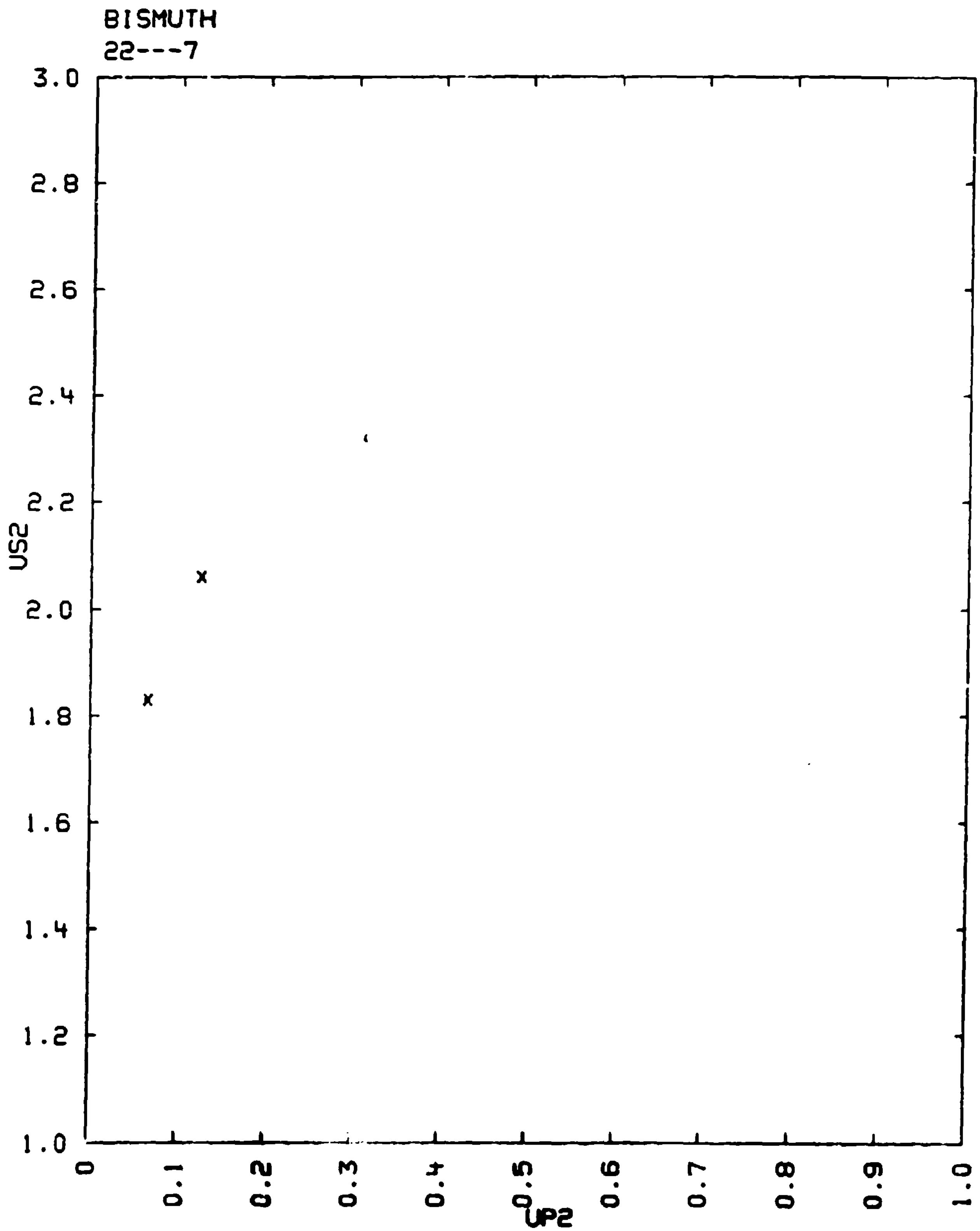

BISMUTH
22---7
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
US2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP2

TABLE IV



BISMUTH
22---7
USI
UP1
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

TABLE IV


BISMUTH
22---7
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
US2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP2

22---8
BISMUTH CAST

BI

VO = 0.1020 CC/G
VO1 = 0.1020 CC/G

IN THE TABLE BELOW, VELOCITIES ARE IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

RHOO	US1	UP1	P1	V1/VO	US2	UP2	P2	V2/VO
9.806	2.051	0.133	26.7	0.9351	1.540	0.262	45.7	0.8494
-	2.056	0.116	23.4	0.9436	1.470	0.235	40.1	0.8607
-	2.056	0.113	22.7	0.9450	1.512	0.239	41.0	0.8599
-	2.052	0.148	29.8	0.9279	1.535	0.236	42.7	0.8690

US =

COMMENTS

1) SOURCE: HUGHES D. S., GOURLEY L. E. AND GOURLEY M. F.
J. APPL. PHYS., VOL. 32, P. 624 (1961)
2) EXPERIMENTAL TECHNIQUE: A AND G
DATA REDUCTION METHOD: DI
3) VO1 WAS OBTAINED FROM WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTER-SCIENCE PUBL., NEW-YORK, 1963) 2ND. EDITION, VOL. 1, P. 32.
4) THE ELASTIC WAVE OBSERVED IN ---7 WAS NEGLECTED IN CALCULATING THE ABOVE POINTS.

TABLE I

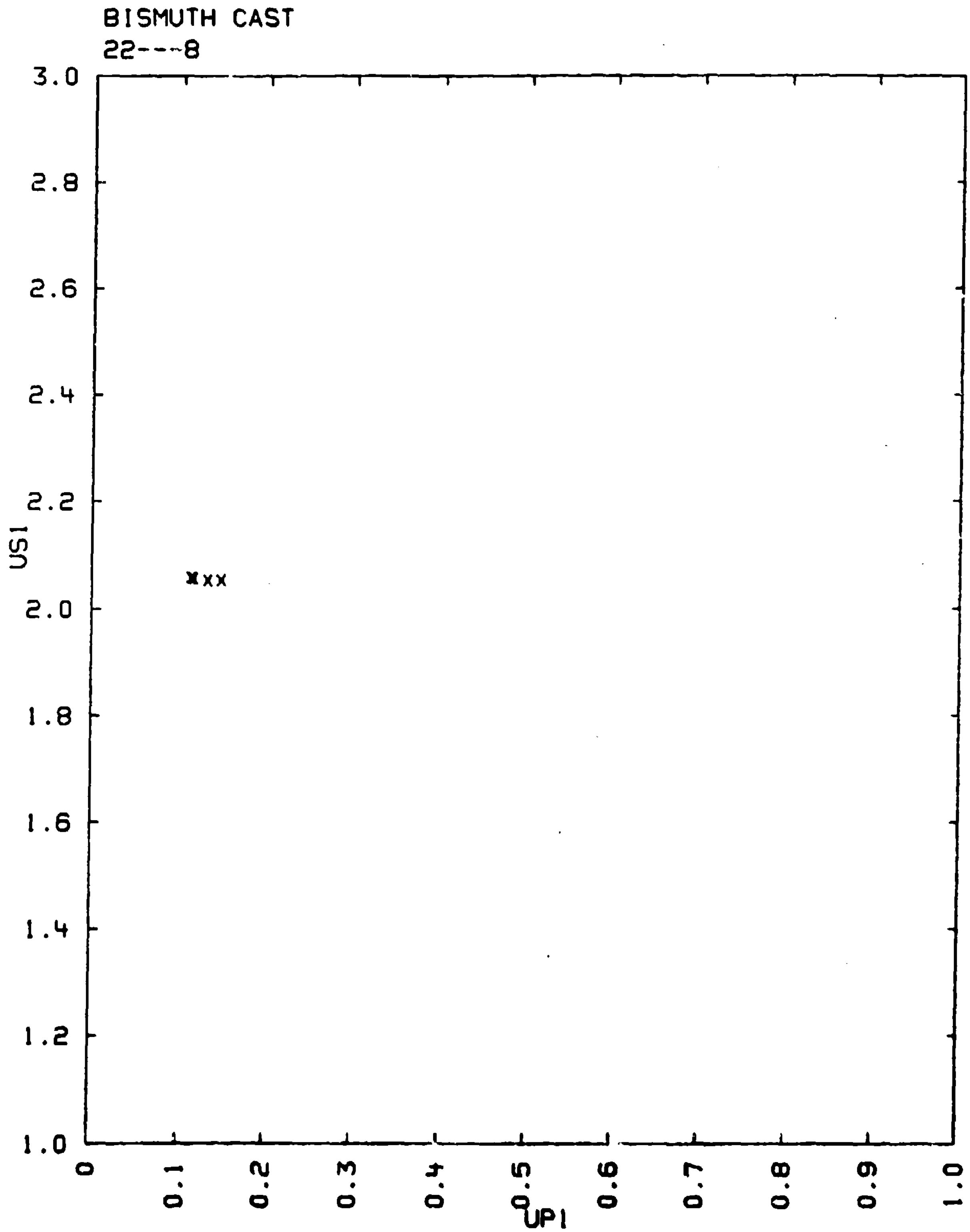
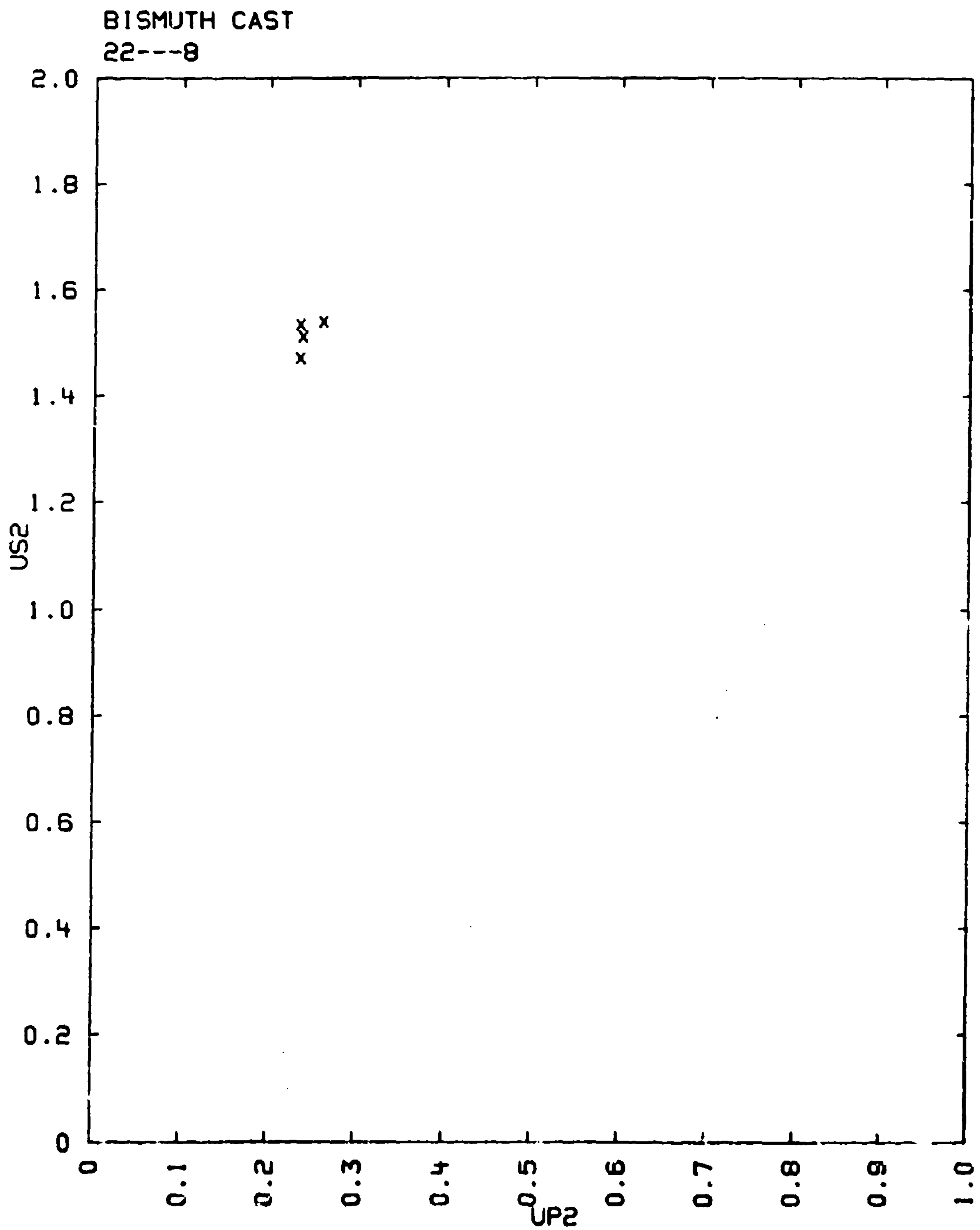

BISMUTH CAST
22---8
US1
UP1
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

TABLE I



BISMUTH CAST
22---8
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
US2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP2

23---1
GRAPHITE PYROLYTIC

C 100 PERCENT

V0 = .455 CC/G CL = 3.45 KM/SEC
V01 = .444 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC, AND PRESSURE IN KILOBARS.

TABLE

US1	UFS1	UP1	P1	V1/V0	US2	UFS2	UP2	P2	V2/V0
7.19	3.92	1.78	281.0	0.752					
6.65	2.62	1.33	193.0	0.802					
5.95	1.93	0.93	122.0	0.844					
5.57	1.62	0.80	98.0	0.858					
5.91	1.97	0.91	118.0	0.847					
5.91	1.93	0.95	123.0	0.842					
6.66	2.82	1.42	207.0	0.788					
7.34		1.73	280.0	0.764					
5.88	1.89	0.92	119.0	0.844					
5.97	1.92	0.90	117.0	0.351					
3.28		0.038	2.7	0.988	4.72		0.515	35.5	0.895
3.2		0.027	1.9		4.30	0.65	0.287	27.2	0.933
3.2		0.027	1.9		4.40	0.63	0.304	29.4	0.930
					5.35	1.17	0.638	75.0	0.881
3.2		0.027	1.9		4.14		0.174	15.7	0.957
3.2		0.012	0.8		5.75		0.830	105.0	0.854
3.2		0.012	0.8		5.54		0.800	98.0	0.855
3.2		0.012	0.8		4.88		0.440	47.2	0.909
3.2		0.012	0.8		4.81		0.415	43.9	0.913

US = 3.70 + 2.41 UP, SIG.US = 0.1 KM/SEC, FOR UP LESS THAN 1.0
US = 4.57 + 1.53 UP, SIG.US = 0.13 KM/SEC, FOR UP GREATER THAN 1.0

COMMENTS:

1) SOURCE: DORAN, D.G.
J. APPL. PHYS., VOL. 34, PP. 844-850 (1963)
HUGONIOT EQUATION OF STATE OF PYROLYTIC GRAPHITE TO 300 KBARS
(POULTER LABORATORIES, STANFORD RESEARCH INSTITUTE, MENLO PARK, CALIFORNIA)
2) EXPERIMENTAL TECHNIQUE C AND D
DATA REDUCTION TECHNIQUE B
(STANDARD MATERIAL ALUMINUM)
3) THE DOUBLE WAVE REPORTED IN GRAPHITE ORIGINATED IN THE DRIVER PLATE, NOT IN THE GRAPHITE. THE SECOND SHOCK AND PARTICLE VELOCITY REPRESENT THE FINAL STATE OF THE SHOCKED GRAPHITE.

TABLE 1

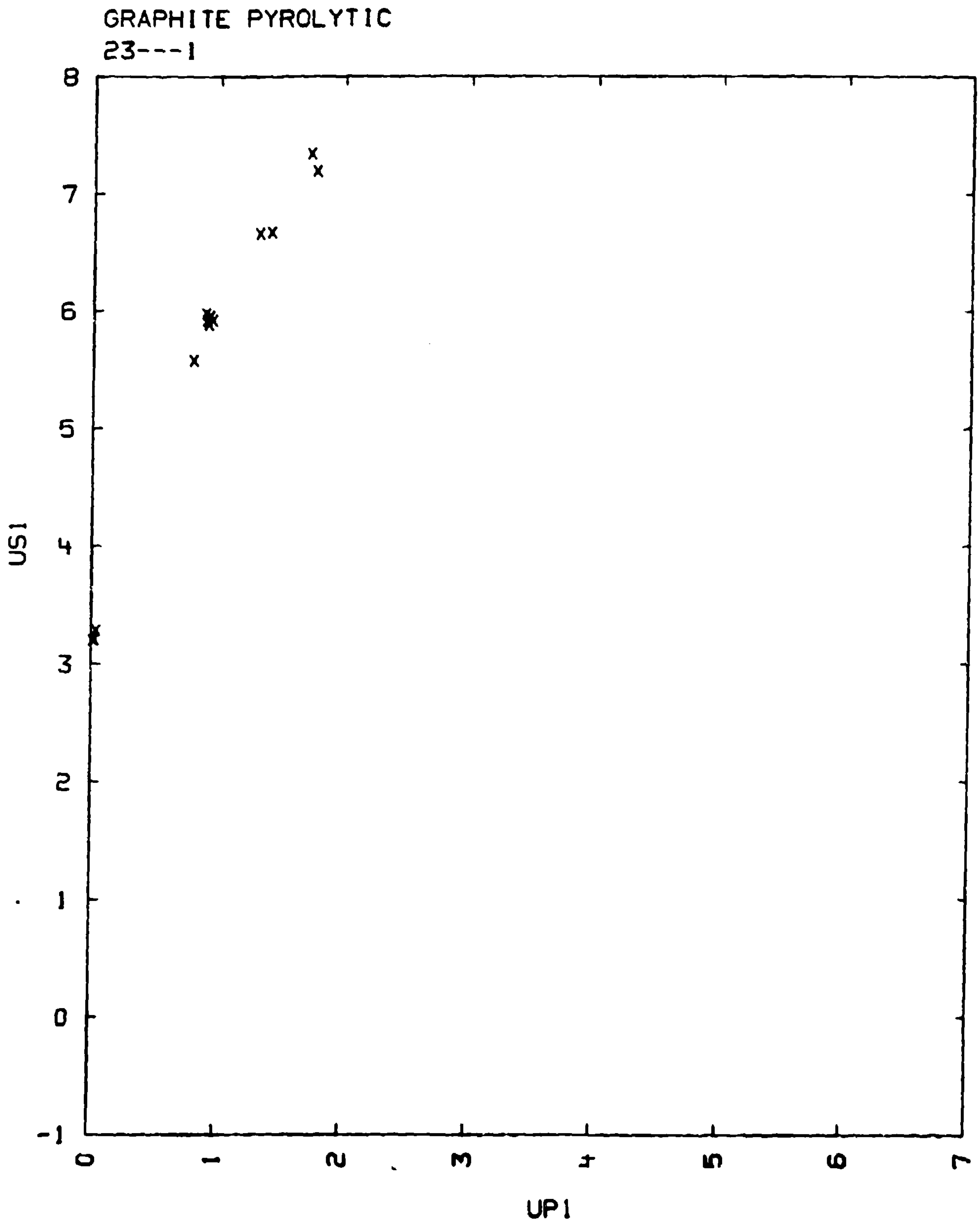
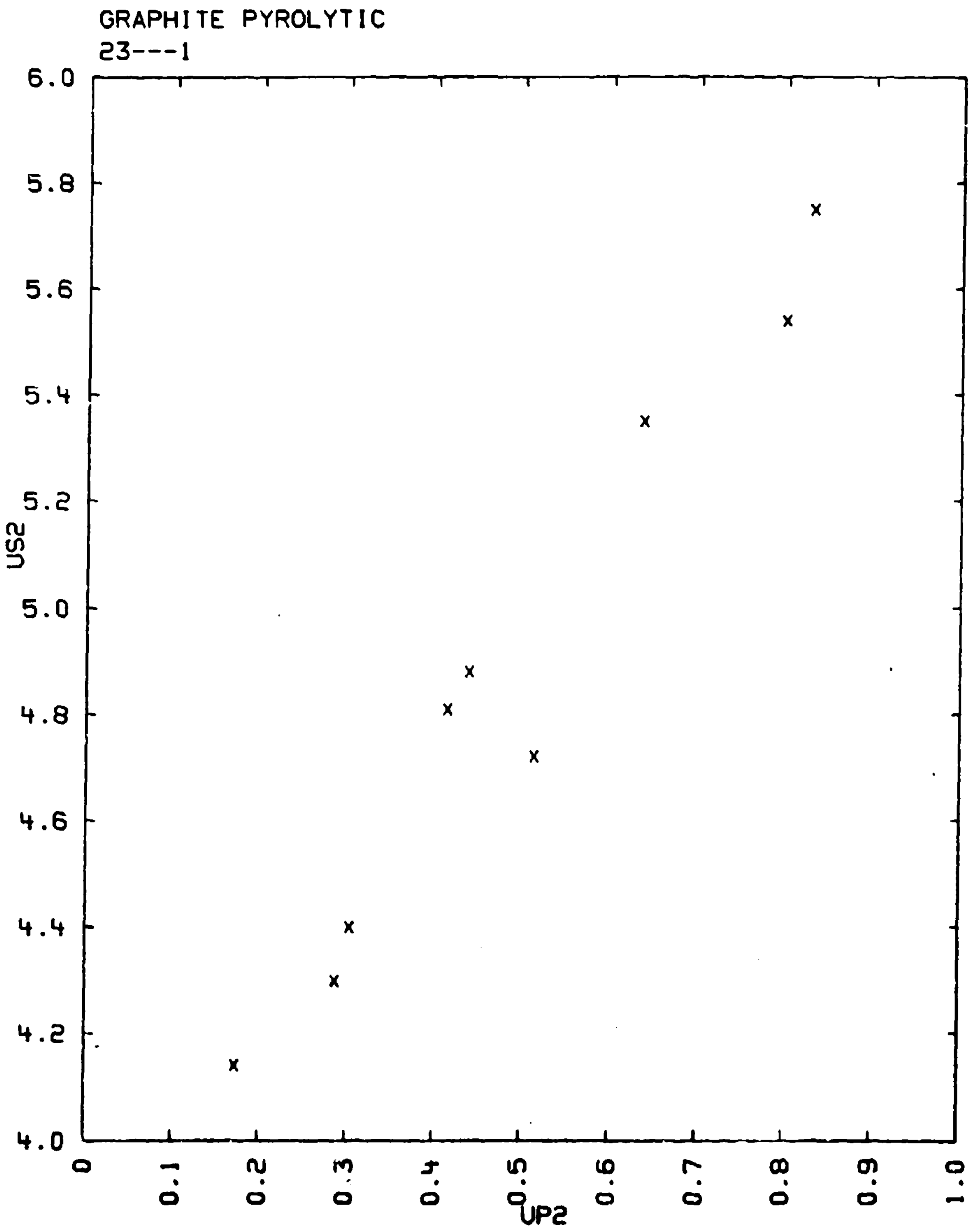


TABLE I


GRAPHITE PYROLYTIC
23---1
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
US2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP2

23---2
GRAPHITE PYROLYTIC

C 100 PERCENT

V0 = 0.456 CC/G
V01 = 0.444 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC, PRESSURE IN KILOBARS, AND SPECIFIC VOLUME IN CC/G.

TABLE

US	UFS	UP	P	V/VO	BASE PLATE	BASE PLATE PRESSURE
5.901	2.360	0.893	115.9	0.847	BRASS	240.0
5.955	2.340	0.885	115.9	0.851	BRASS	240.0
5.790	1.760	0.855	108.9	0.852	BRASS	227.0
5.790	1.760	0.860	109.5	0.851	BRASS	227.0
5.514	1.586	0.787	95.5	0.857	BRASS	202.0
4.932	-	0.464	50.3	0.906	BRASS	108.0
4.932	-	0.464	50.3	0.906	BRASS	108.0
4.420	-	0.305	29.7	0.931	BRASS	95.4
4.420	-	0.305	29.7	0.931	BRASS	95.4
5.016	-	0.404	44.6	0.919	BRASS	108.0
5.003	-	0.479	52.7	0.904	BRASS	108.0
4.750	-	0.350	36.6	0.926	BRASS	95.4
5.750	1.762	(0.881)	111.4	0.847	BRASS	-
5.700	1.768	(0.884)	110.9	0.845	BRASS	-
5.440	1.668	0.798	95.5	0.853	BRASS	200.0
5.440	1.760	0.802	96.0	0.853	BRASS	200.0
6.550	2.796	1.504	216.7	0.770	AL	254.0
6.617	2.786	1.487	216.5	0.775	AL	254.0
6.337	2.574	1.237	172.5	0.805	AL	206.0
6.284	2.512	1.239	171.3	0.803	AL	206.0
7.803	4.656	2.252	386.6	0.711	BRASS	752.0
8.370	5.032	(2.516)	463.3	0.699	AL	318.0
8.342	4.980	2.501	459.0	0.700	AL	543.0
7.445	-	1.900	311.2	0.745	AL	356.0
7.628	-	2.180	365.8	0.714	BRASS	566.0
8.322	4.780	2.332	427.0	0.720	AL	318.0
7.577	4.118	(2.059)	343.2	0.728	BRASS	-

US = 3.91 + 2.14 UP, SIG.US = 0.14 BELOW UP = 1.0 KM/SEC.
US = 5.01 + 1.05 UP, SIG.US = 0.05 FOR UP BETWEEN 1.0 AND 1.7 KM/SEC.
US = 4.20 + 1.66*UP, SIG.US = 0.20 ABOVE UP = 1.7 KM/SEC.

COMMENTS:

1) SOURCE: COLEBURN, N. L.
J. CHEM. PHYS., V.40, P.71 (1964)

REPORT NO. NOLTR 63-73 (1963)
THE COMPRESSIBILITY OF PYROLYTIC GRAPHITE
UNITED STATES NAVAL ORDNANCE LABORATORY, WHITE OAK, SILVER SPRING, MARYLAND.

2) EXPERIMENTAL TECHNIQUE B AND C
DATA REDUCTION TECHNIQUE B AND D
UP OBTAINED BY TECHNIQUE D IS ENCLOSED IN PARENTHESES.

3) THE PYROLYTIC GRAPHITE WAS OBTAINED FROM HIGH TEMPERATURES MATERIALS, INC., LOWELL, MASS.

4) LONGITUDINAL SOUND VELOCITY:
C-AXIS NORMAL TO THE ORIGINAL PLANE OF DEPOSITION OF GRAPHITE
A-AXIS PARALLEL TO ORIGINAL PLANE OF DEPOSITION

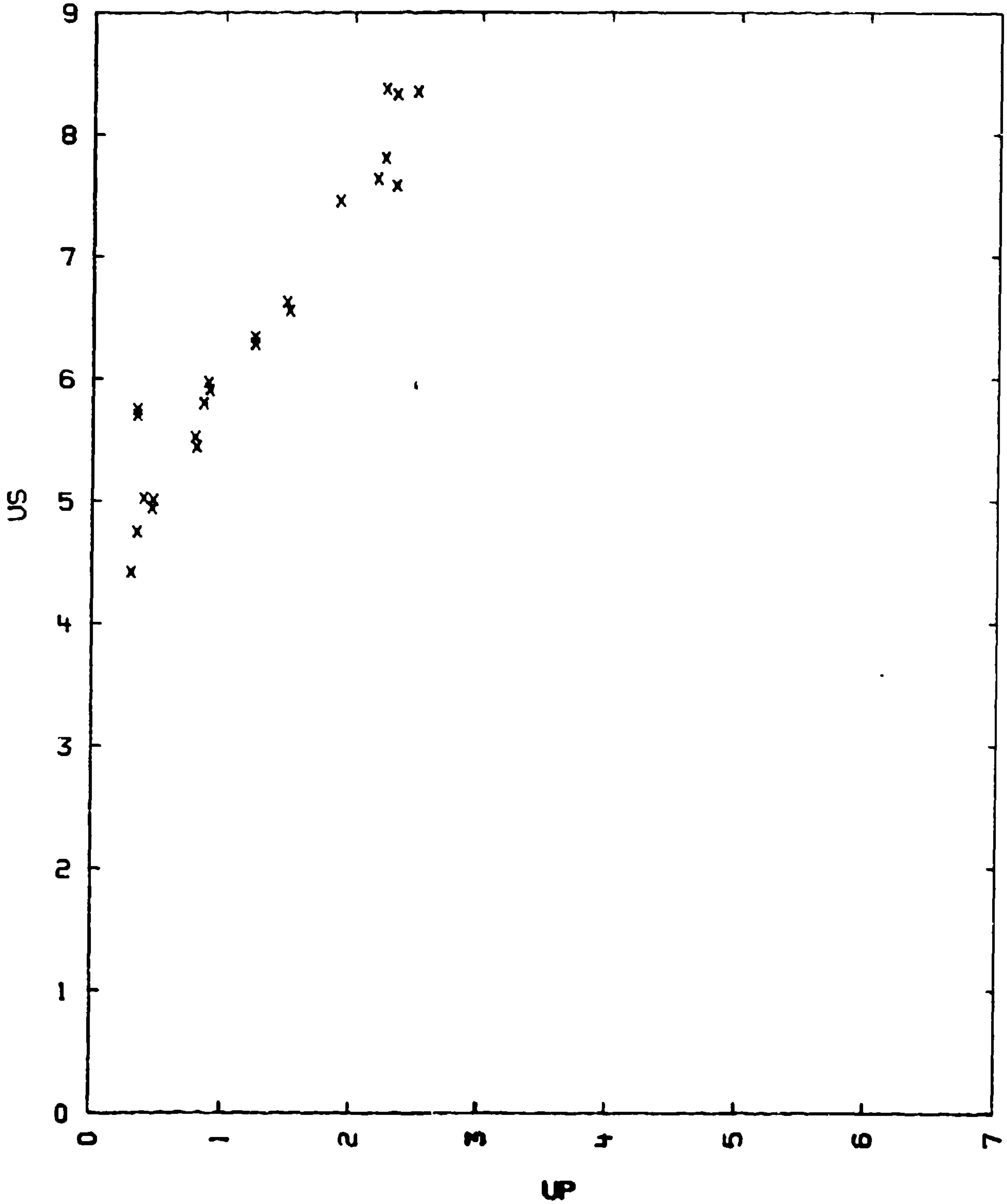
TABLE

C-AXIS		A-AXIS	
TEMP. DEG. K.	VELOCITY KM/SEC.	TEMP. DEG. K.	VELOCITY KM/SEC.
51	3.518	298	4.791
62	3.516		
78	3.512		
103	3.507		
130	3.495		
165	3.483		
199	3.465		
234	3.460		
254	3.454		
273	3.446		
293	3.443		
313	3.433		
334	3.430		

5) THERE WAS NO MEASURABLE DIFFERENCE BETWEEN THE SHOCK VELOCITIES ALONG THE C AND A AXES.

TABLE I

GRAPHITE PYROLYTIC
23---2



23---3
GRAPHITE COMMERCIAL

C

VO = 0.6143 CC/G
VOI = 0.4412 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC

TABLE

------------SAMPLE------------					-----STANDARD-----	
RHOO	US	UP	P	V/VO	UFS(ST) (ALUMINUM)	UFS(ST) (MAGNESIUM)
1.628	5.312	2.331	200.5	0.561		4.080
-	5.192	2.347	199.5	0.548		4.080
-	5.263	2.442	210	0.536		4.260
-	5.263	2.343	201.5	0.565		4.100
-	4.960	2.062	167	0.584	2.990	
-	4.907	2.100	168	0.572	3.030	
-	5.071	2.048	170	0.578	3.020	
-	5.192	2.011	171	0.594	2.980	
-	4.634	1.893	142	0.591	2.700	
-	4.634	1.880	141	0.594	2.690	
-	4.726	1.909	147	0.596	2.740	
-	4.726	1.896	146	0.599	2.720	
-	4.583	1.913	143.5	0.583	2.740	
-	4.583	1.967	147.5	0.571	2.800	
-	4.695	1.829	139	0.610	2.630	
-	4.695	1.829	139	0.610	2.630	
-	4.241	1.739	120	0.590	2.430	
-	4.184	1.728	117.5	0.587	2.415	
-	4.464	1.760	128.5	0.606	2.505	
-	4.378	1.746	124	0.601	2.485	
-	4.115	1.537	103	0.626	2.160	
-	4.115	1.537	103	0.626	2.160	
-	4.039	1.576	104	0.610	2.200	
-	4.115	1.530	102.5	0.628	2.140	
-	3.720	1.336	81.5	0.641	1.835	
-	3.782	1.331	82.5	0.648	1.835	
-	3.660	1.350	81	0.631	1.835	
-	3.660	1.350	81	0.631	1.835	
-	3.448	1.286	72	0.627	1.720	
-	3.390	1.300	71.5	0.617	1.745	
-	3.472	1.246	71	0.641	1.695	
-	3.526	1.246	71	0.647	1.695	
-	3.526	1.246	71	0.647	1.695	
-	3.185	1.135	59	0.644	1.495	
-	3.123	1.137	58	0.636	1.495	
-	2.761	0.911	41	0.670	1.185	
-	2.778	0.933	42	0.664	1.197	
-	3.023	1.020	50	0.663	1.335	

GRAPHITE COMMERCIAL

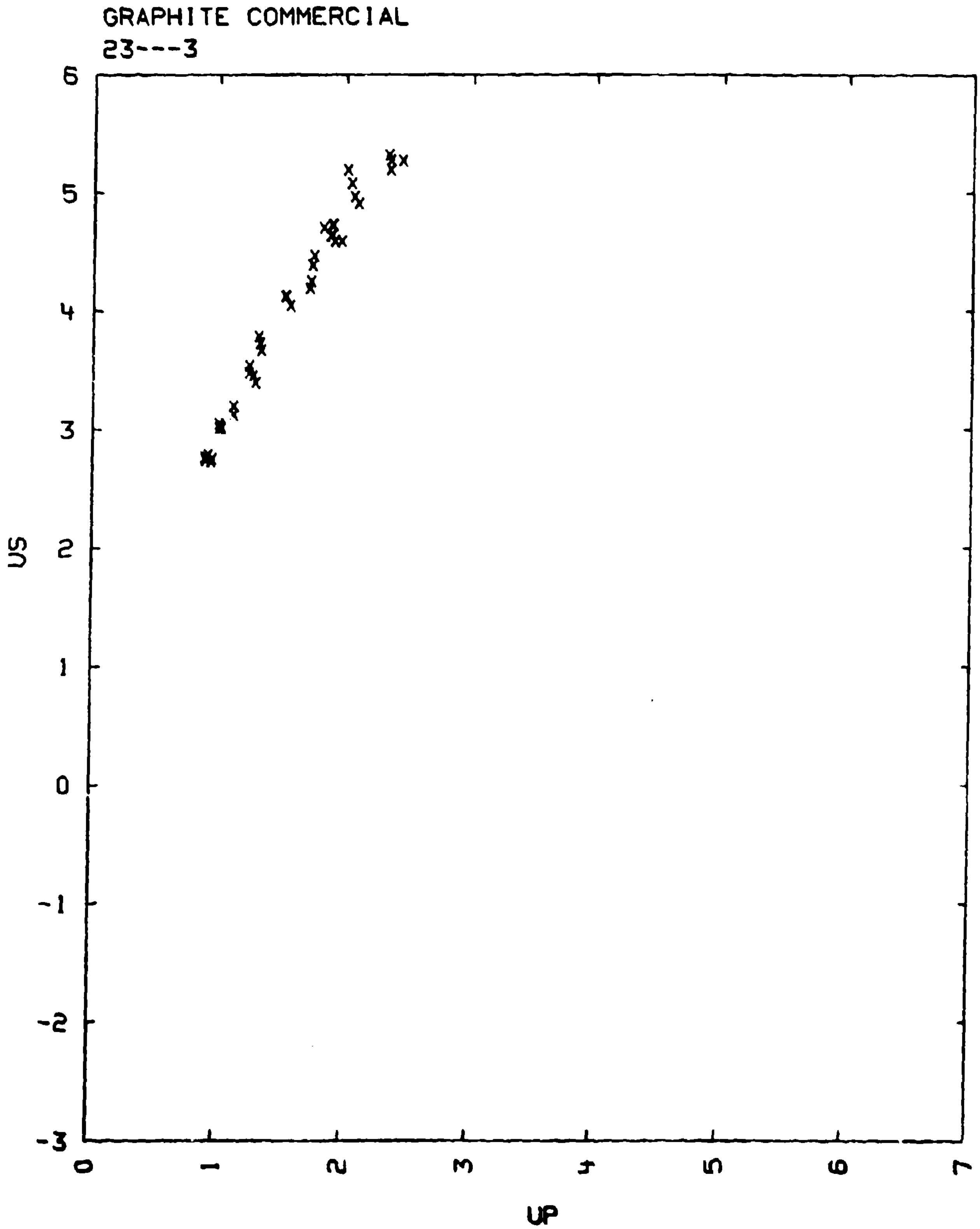
RHOO	US	UP	P	V/VO	UFS(ST)	UFS(ST)
-	3.003	1.041	51	0.653	1.350	
-	3.043	1.010	50.5	0.668	1.330	
-	3.003	1.010	49.5	0.664	1.330	
-	2.726	0.955	42	0.650	1.215	
-	2.743	0.956	43	0.651	1.215	
-	2.761	0.911	41	0.670	1.175	
-	2.737	0.912	41.5	0.663	1.190	

US = 1.162 + 1.822 UP KM/SEC.

COMMENTS:

1) SOURCE: BERGER J. AND FAUQUIGNON C.
PRIVATE COMMUNICATION (1964), B.P. NO. 7, SEVRAN, FRANCE
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIALS, MAGNESIUM AND ALUMINUM AU4G ALLOY
3) VOI WAS OBTAINED FROM CRYSTAL DATA DETERMINATIVE TABLE (AMERICAN CRYSTALLOGRAPHIC ASSOCIATION) 2ND ED., APRIL 1, 1963.
4) SAMPLE DIMENSIONS WERE: 2.0 CM DIAMETER
0.5 CM THICKNESS

TABLE I



23---4
CARBON (GRAPHITE, CEYLON-PRESSED)

C

VO = 0.460 CC/G
VOI = 0.4412 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC. D IS SAMPLE THICKNESS IN MM.

TABLE

SAMPLE							BASEPLATE
RHO0	US	UFS	UP	P	V/V0	D	P
2.185	7.60		2.94	468	.613	6.2	612
2.185	7.43	5.19				3.1	612
2.181	7.41		3.02	488	.593	6.2	624
2.181	7.34	5.15				3.1	624
2.180	7.87		3.36	576	.573	6.2	730
2.180	7.99	5.45				3.1	730
2.170	6.91		2.72	408	.606	6.2	532
2.170	6.68	4.72				3.1	532
2.180	7.93		3.26	564	.589	6.2	707
2.180	7.79	5.52				3.1	707
2.179	6.47		2.21	311	.659	6.2	395
2.179	6.36	3.77				3.1	395
2.172	7.78		3.38	571	.566	6.2	730
2.170	7.65		3.31	549	.567	6.2	707
2.181	6.50	3.76	2.20	312	.661	6.2	401
2.179	6.52		2.20	312	.662	6.2	401

US = 3.90 + 1.177*UP KM/SEC.
SIG.US = 0.14 KM/SEC.

COMMENTS:

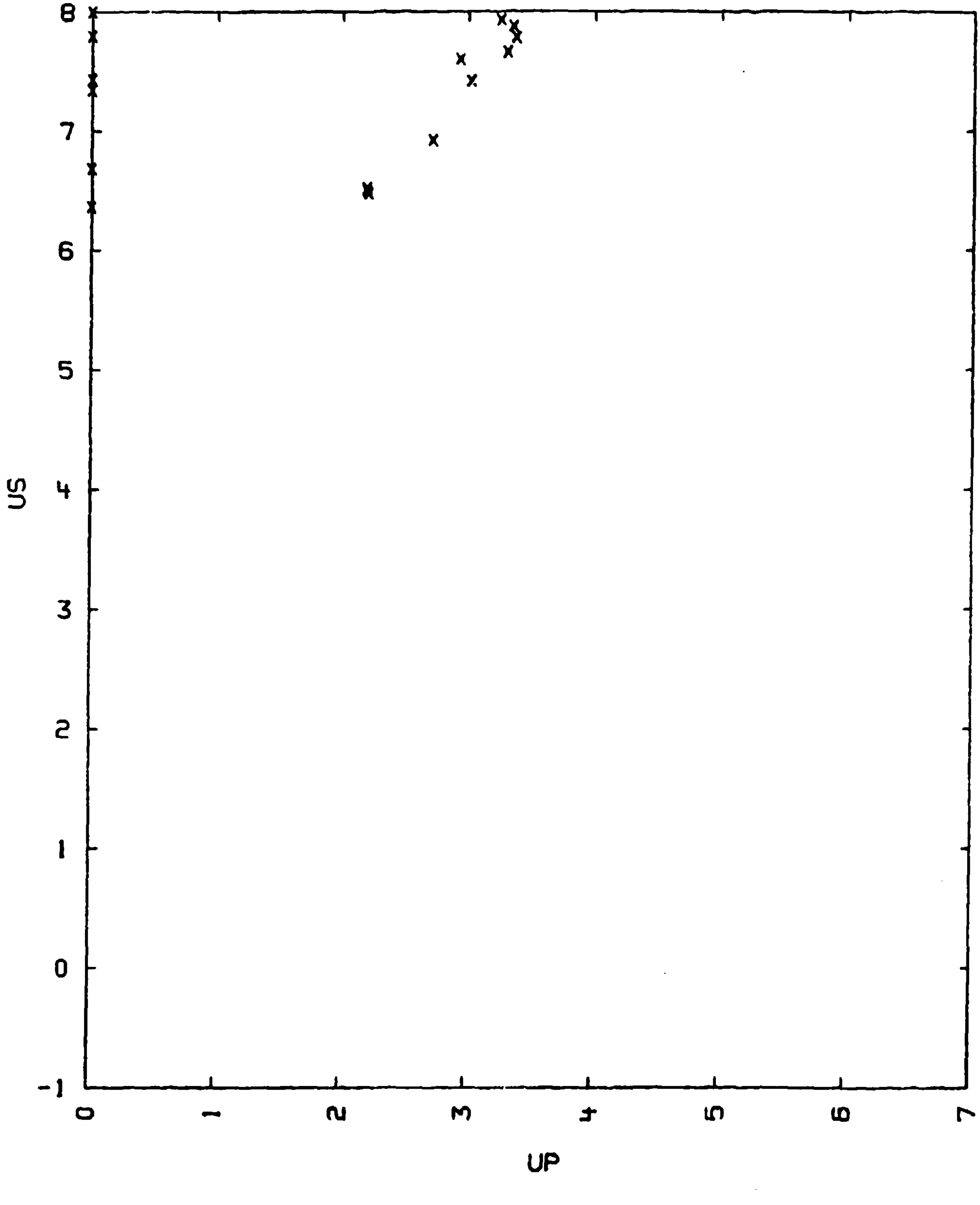
1) SOURCE: COMPILER
L. R. L. EQUATION OF STATE FILE
LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIFORNIA.
2) EXPERIMENTAL TECHNIQUE B. (ALUMINUM STANDARD BASE PLATE)
DATA REDUCTION TECHNIQUE B.
3) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF THE HEXAGONAL UNIT CELL:
A = 2.4612 ANGSTROMS, C = 6.7079 ANGSTROMS, A.C.A. MONOGRAPH NO.5
CRYSTAL DATA DETERMINATIVE TABLES, 2ND EDITION
(AMERICAN CRYSTALLOGRAPHIC ASSOCIATION 1963)
4) THE ABOVE DATA AND DATA FOR COMMERCIAL CARBON, (23---5), HAVE BEEN DISCUSSED BY B. J. ALDER AND R. H. CHRISTIAN IN PHYS. REV. LETTERS VOL. 7, P. 367 (1963).

5) DATA ABOVE 650 KILOBARS DISCUSSED BY ALDER AND CHRISTIAN ARE OMITTED BECAUSE OF EXPECTED INTERFERENCE BY AN ELASTIC RELEASE HAVE CAUSED BY A VERY THIN PROJECTILE PLATE THAT HAS USED TO OBTAIN HIGHER PRESSURES.

TABLE I

CARBON (GRAPHITE, CEYLON-PRESSED)

23---4



23---5
CARBON (GRAPHITE, COMMERCIAL) (ATJ)

C

VO = 0.568 CC/G   CL = 2.54 KM/SEC   CO = 1.68 KM/SEC
VOI = 0.4412 CC/G   CS = 1.65 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC. UFS OBTAINED ON 3MM SAMPLES ONLY.

TABLE

- - - - - -	- - -	- SAMPLE	- - -	- - -	- - -	- - -	BASEPLATE
RHOO	US	UFS	UP	P	V/VO	D	P
1.673	5.05		2.00	171	0.604	6	296
1.673	5.09	3.22				3	296
1.685	5.44		2.23	202	0.590	6	351
1.685	5.35	3.56				3	351
1.761	7.13		3.76	472	0.603	6	738
1.761		7.08				3	738
1.775	6.39		3.35	374	0.610	6	612
1.755		5.5				3	612
1.739	5.64		2.26	217	0.599	6	356
1.739	5.78	3.62				3	356
1.796	5.30		1.78	169	0.664	6	268
1.796	5.25	3.09				3	268
1.802	7.61	5.96	4.55	617	0.402	3	958
1.812	6.68		3.22	319	0.521	6	590
1.812	6.51	5.18				3	590

US = 3.32 + 0.99*UP KM/SEC
SIG.US = 0.21 KM/SEC.

COMMENTS:

1) SOURCE: COMPILER
L. R. L. EQUATION OF STATE FILE
LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIFORNIA.
2) EXPERIMENTAL TECHNIQUE B (ALUMINUM STANDARD BASE PLATE).
DATA REDUCTION TECHNIQUE B.
3) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF THE HEXAGONAL UNIT CELL:
A = 2.4612 ANGSTROMS, C = 6.7079 ANGSTROMS. A.C.A. MONOGRAPH NO.5
CRYSTAL DATA DETERMINATIVE TABLES, 2ND EDITION
AMERICAN CRYSTALLOGRAPHIC ASSOCIATION (1963).
4) SOUND VELOCITY WAS MEASURED BY H. L. DUNEGAN, SUPPORT ENGINEERING ULTRASONICS GROUP, LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIF.
5) THE ABOVE DATA AND DATA FOR CEYLON GRAPHITE (23---4), HAVE BEEN DISCUSSED BY B. J. ALDER AND R. H. CHRISTIAN IN PHYS. REV. LETTERS

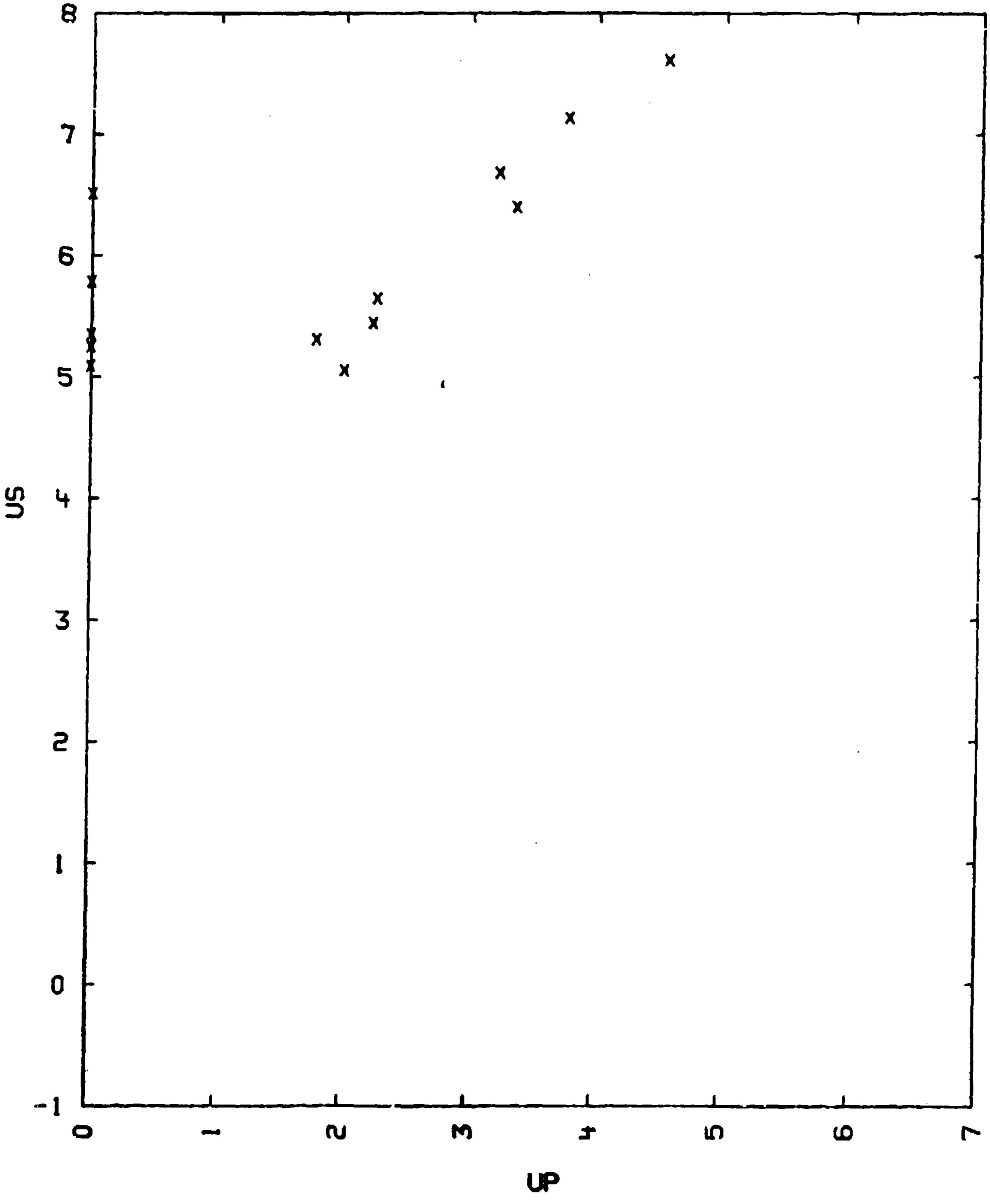
VOL. 7, P. 3E7 (1963).

6) DATA ABOVE 530 KILOBARS DISCUSSED BY ALDER AND CHRISTIAN ARE OMITTED BECAUSE OF EXPECTED INTERFERENCE BY AN ELASTIC RELEASE WAVE CAUSED BY A VERY THIN PROJECTILE PLATE THAT HAS USED TO OBTAIN HIGHER PRESSURES.

TABLE I

CARBON (GRAPHITE, COMMERCIAL) (ATJ)

23---5



23---6
CARBON,(GRAPHITE PYROLYTIC)

C

VO = 0.455 CC/G CL = 3.45 KM/SEC
VOI = 0.4412 CC/G CB = 3.9 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

- - - - - - - - - SAMPLE	- - - - - - -				STANDARD
RHOO	US	UP	P	V/VO	US(ST)
2.20	3.90	0.	0.	1.0000	0.
2.20	5.18	0.37	43.	0.9286	5.88
2.20	5.17	0.37	43.	0.9284	5.88
2.20	5.14	0.37	42.	0.9280	5.88
2.20	6.17	0.83	114.	0.8655	6.44
2.20	6.05	0.84	112.	0.8612	6.44
2.20	6.01	0.84	112.	0.8602	6.44
2.23	6.19	0.99	137.	0.8401	6.62
2.20	6.41	1.01	142.	0.8424	6.64
2.22	6.76	1.30	196.	0.8077	7.00
2.22	6.78	1.30	196.	0.8083	7.00
2.20	6.75	1.33	197.	0.8030	7.02
2.20	6.72	1.33	197.	0.8021	7.02
2.20	6.66	1.33	195.	0.8003	7.02
2.20	7.01	1.46	225.	0.7917	7.18
2.20	6.97	1.46	224.	0.7905	7.18
2.20	6.97	1.46	224.	0.7905	7.18
2.22	7.64	1.81	308.	0.7631	7.64
2.20	7.64	1.82	306.	0.7618	7.63
2.20	7.57	1.83	305.	0.7583	7.64
2.20	7.55	1.83	304.	0.7576	7.64
2.20	7.50	1.83	303.	0.7560	7.64
2.23	7.85	2.00	351.	0.7452	7.87
2.21	8.02	2.16	383.	0.7307	8.05
2.20	8.28	2.30	420.	0.7222	8.23
2.20	8.24	2.31	419.	0.7197	8.23
2.20	8.19	2.31	417.	0.7179	8.23
2.20	8.29	2.33	425.	0.7189	8.26
2.20	8.24	2.33	424.	0.7172	8.26
2.20	8.21	2.34	423.	0.7150	8.26
2.22	8.11	2.42	436.	0.7016	8.34
2.21	8.18	2.49	451.	0.6956	8.42
2.21	8.36	2.58	478.	0.6914	8.54
2.20	8.33	2.81	515.	0.6627	8.77
2.20	8.26	2.82	513.	0.6586	8.77
2.20	8.24	2.82	512.	0.6578	8.77
2.23	8.28	3.17	585.	0.6171	9.14
2.22	8.06	3.22	577.	0.6005	9.16
2.21	8.21	3.37	612.	0.5895	9.33
2.20	8.43	3.46	642.	0.5896	9.45

CARBON, (GRAPHITE PYROLYTIC)

RHOO	US	UP	P	V/VO	US(ST)
2.20	8.38	3.46	640.	0.5871	9.45
2.20	8.36	3.47	639.	0.5849	9.45
2.20	8.37	3.55	652.	0.5759	9.52
2.21	8.57	3.58	676.	0.5823	9.59
2.20	8.56	3.65	687.	0.5736	9.66
2.23	9.13	3.68	749.	0.5969	9.79
2.21	8.86	3.68	720.	0.5847	9.74
2.21	9.17	3.69	747.	0.5976	9.79
2.22	9.17	3.72	759.	0.5943	9.84
2.20	9.07	3.76	751.	0.5854	9.85
2.24	9.21	3.77	777.	0.5907	9.90
2.21	9.47	3.95	828.	0.5829	10.11
2.23	9.41	3.96	831.	0.5792	10.13

US = 4.74 + 1.53*UP KM/SEC .8<UP<2.3
SIG US = 0.067 KM/SEC
US = 3.9 + 2.3*UP KM/SEC 3.25<UP<4.
SIG US = 0.22 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
HUGONIOTS OF GRAPHITES OF VARIOUS INITIAL DENSITIES AND THE EQUATION OF STATE OF CARBON.
SYMPOSIUM ON THE 'BEHAVIOR OF DENSE MEDIA UNDER HIGH DYNAMIC PRESSURE', I.U T.A.M. PARIS, 1967
(GORDON AND BREACH, N.Y. 1968)
2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION METHOD B.
STANDARD MATERIAL 2024 ALUMINUM WITH LINEAR SHOCK VELOCITY-PARTICLE VELOCITY HUGONIOT RELATIONSHIP US = 5.46 + 1.318*UP KM/SEC
RHOO = 2.785 G/CC, GRUNEISEN RATIO = 1.89 = V*(DP/DE)
3) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS:
A = 2.4612 ANGSTROMS, C = 6.7079 ANGSTROMS: A.C.A. MONOGRAPH NO.5
CRYSTAL DATA DETERMINATIVE TABLES, 2ND EDITION,
AMERICAN CRYSTALLOGRAPHIC ASSOCIATION (1963).
4) THE GRUNEISEN RATIO OF THE LOW PRESSURE PHASE = 1.71/RHO YIELDS A GOOD FIT TO THE POROUS DATA OF 23---7 AND WITH A PYROLYTIC EOS CENTERED ON THE IDEAL DENSITY.

TABLE I

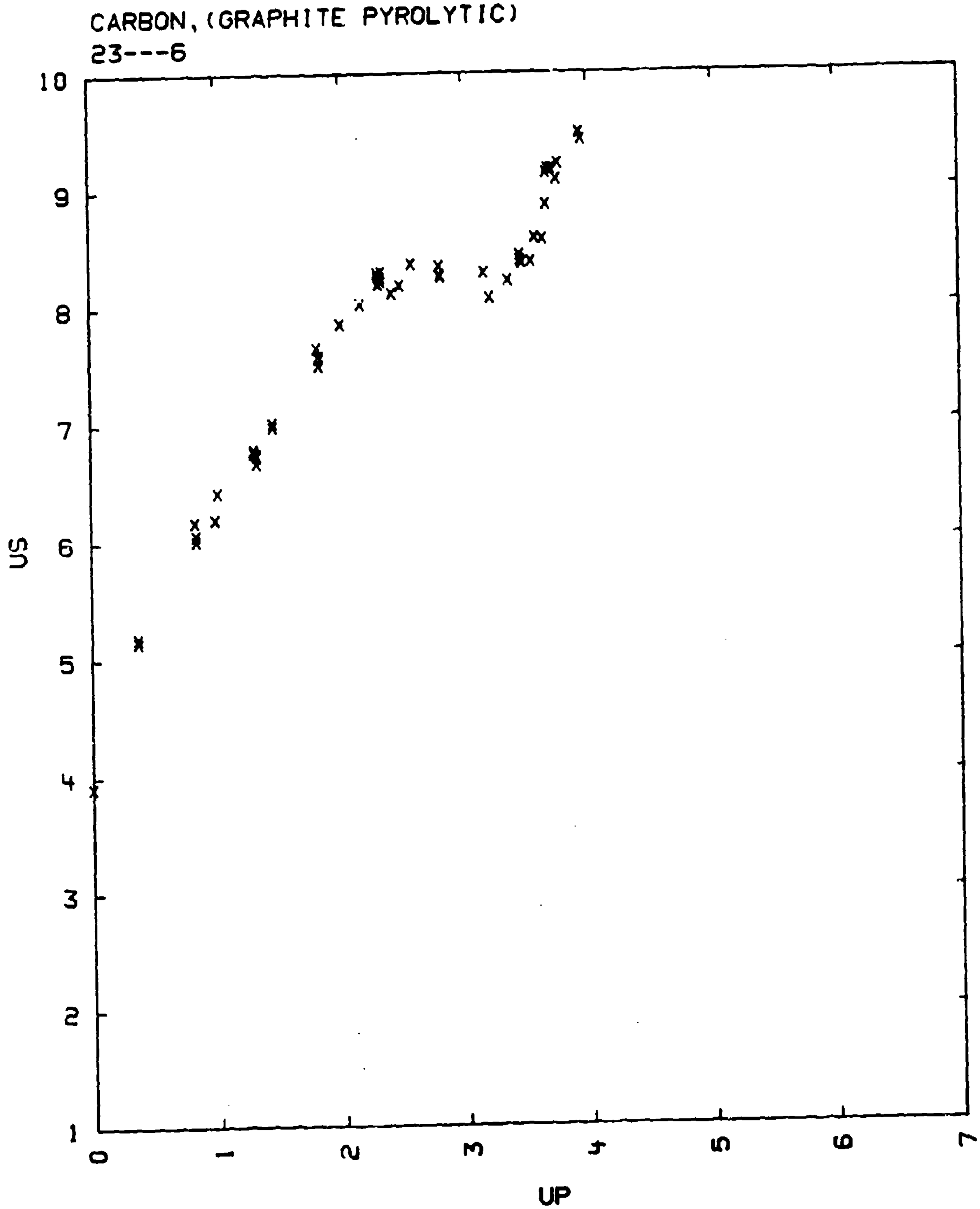
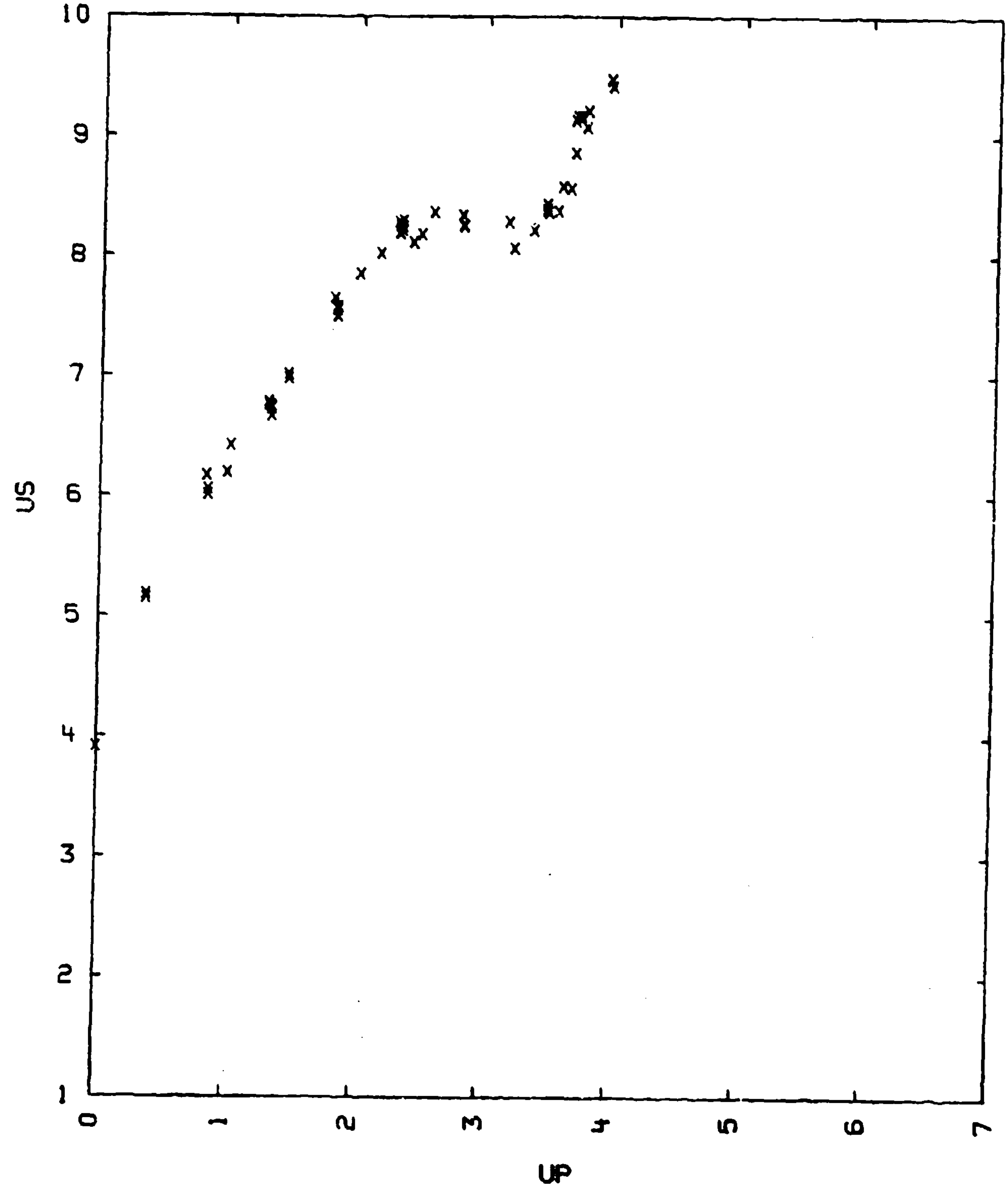


TABLE I

CARBON, (GRAPHITE PYROLYTIC)
23---6



23---7
CARBON (GRAPHITE POROUS)

C

VO = 1/RHOO CC/G
VOI = 0.4412 CC/G

IN THE TABLES BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE I

- - - - - - - - -	SAMPLE	- - - - - - - -			STANDARD
RHOO	US	UP	P	V/VO	US(ST)
2.11	5.31	1.01	113.	0.8098	6.55
2.12	6.10	1.37	178.	0.7754	6.99
2.12	6.41	1.98	270.	0.6911	7.65
2.14	6.65	2.64	376.	0.6030	8.34
2.14	6.80	2.81	410.	0.5868	8.54
2.15	8.08	3.42	594.	0.5767	9.33
2.14	8.89	3.81	726.	0.5714	9.84
2.13	0.96	3.87	740.	0.5681	9.90
2.13	9.34	4.02	802.	0.5696	10.11
2.14	9.77	4.22	880.	0.5681	10.38
2.14	9.70	4.37	907.	0.5495	10.53

US = 3.1 + 2.2*UP KM/SEC 1.0<UP<1.4
SIG US = ?
US = 1.30 + 1.98*UP KM/SEC 2.7<UP<4.5
SIG US = 0.23 KM/SEC

TABLE II

- - - - - - - - -	SAMPLE	- - - - - - - -			STANDARD
RHOO	US	UP	P	V/VO	US(ST)
2.04	3.46	0.35	24.	0.8994	5.79
2.03	3.51	0.37	26.	0.8946	5.81
2.04	4.41	0.90	81.	0.7959	6.37
2.03	4.41	0.91	81.	0.7937	6.37
2.02	4.91	1.06	106.	0.7841	6.56
2.04	4.94	1.07	108.	0.7834	6.57
2.01	5.58	1.39	156.	0.7509	6.94
2.03	5.62	1.40	160.	0.7509	6.96
2.04	6.10	1.82	226.	0.7016	7.42
2.03	6.11	1.82	225.	0.7021	7.42
2.01	6.11	1.84	227.	0.6989	7.44
2.04	6.14	1.85	232.	0.6987	7.46
2.04	6.11	1.86	231.	0.6956	7.46
2.01	6.15	1.90	235.	0.6911	7.50

CARBON (GRAPHITE POROUS)

RHOO	US	UP	P	V/VO	US(ST)
2.01	6.96	2.97	417.	0.5733	8.66
2.00	6.98	2.98	416.	0.5731	8.66
2.03	7.30	3.19	472.	0.5630	8.92
2.02	7.28	3.20	469.	0.5604	8.92
2.03	7.68	3.44	536.	0.5521	9.22
2.01	7.70	3.44	533.	0.5532	9.22
2.03	7.93	3.71	598.	0.5322	9.53

US = 2.72 + 2.02*UP KM/SEC 0.3<UP<1.6
SIG US = 0.20 KM/SEC
US = 2.87 + 1.38*UP KM/SEC 2.6<UP<4.
SIG US = 0.12 KM/SEC

TABLE III

--------- SAMPLE -------					STANDARD
RHOO	US	UP	P	V/VO	US(ST)
1.96	4.15	0.92	75.	0.7783	6.36
1.94	4.45	1.10	95.	0.7528	6.55
1.95	5.36	1.48	155.	0.7239	6.99
1.96	5.94	1.83	214.	0.6919	7.40
1.95	5.90	1.84	212.	0.6881	7.40
1.95	6.08	2.08	246.	0.6579	7.65
1.95	6.13	2.20	263.	0.6411	7.77
1.94	6.11	2.21	262.	0.6383	7.77
1.95	6.23	2.37	288.	0.6196	7.95
1.96	6.51	2.74	340.	0.5791	8.34
1.95	6.42	2.79	348.	0.5654	8.37
1.94	6.38	2.80	346.	0.5611	8.37
1.94	6.53	2.95	373.	0.5482	8.54
1.95	6.97	3.15	428.	0.5481	8.80
1.95	7.03	3.24	443.	0.5391	8.89
1.94	7.01	3.24	441.	0.5378	8.89
1.94	7.44	3.55	513.	0.5228	9.24
1.93	7.46	3.55	511.	0.5241	9.24
1.94	7.60	3.61	534.	0.5250	9.33
1.95	8.50	3.99	664.	0.5306	9.84
1.95	8.52	4.06	674.	0.5235	9.90
1.96	8.91	4.21	734.	0.5275	10.11
1.95	8.78	4.25	726.	0.5159	10.13
1.95	9.43	4.55	838.	0.5175	10.53

US = 2.34 + 1.97*UP KM/SEC 0.9<UP<1.85
SIG US = 0.20 KM/SEC
US = 1.50 + 1.72*UP KM/SEC 2.8<UP<4.6
SIG US = 0.24 KM/SEC

TABLE IV

--------- SAMPLE -------					STANDARD
RHOO	US	UP	P	V/VO	US(ST)
1.88	3.85	0.95	69.	0.7532	6.36
1.88	4.23	1.13	90.	0.7329	6.55
1.88	5.07	1.52	145.	0.7002	6.99
1.88	5.68	1.89	201.	0.6673	7.40
1.88	5.98	2.11	238.	0.6472	7.65
1.88	6.06	2.24	255.	0.6304	7.77
1.88	6.27	2.39	282.	0.6188	7.95
1.88	6.32	2.80	332.	0.5570	8.34
1.88	6.42	2.82	340.	0.5607	8.37
1.87	6.48	2.98	363.	0.5401	8.54
1.88	6.89	3.20	414.	0.5356	8.80
1.88	6.98	3.28	430.	0.5301	8.89
1.88	7.33	3.60	497.	0.5089	9.24
1.88	7.45	3.68	514.	0.5060	9.33
1.88	8.37	4.13	649.	0.5066	9.90
1.87	8.62	4.32	697.	0.4988	10.11
1.87	8.58	4.34	697.	0.4942	10.13
1.88	8.87	4.55	757.	0.4870	10.38
1.87	9.27	4.64	806.	0.4995	10.53

US = 2.00 + 1.97*UP KM/SEC 0.9<UP<1.9
SIG US = 0.19 KM/SEC
US = 1.73 + 1.59*UP KM/SEC 2.9<UP<4.7
SIG US = 0.26 KM/SEC

TABLE V

--------- SAMPLE -------					STANDARD
RHOO	US	UP	P	V/VO	US(ST)
1.79	3.57	0.98	63.	0.7255	6.36
1.76	3.83	1.18	79.	0.6919	6.55
1.77	4.15	1.26	92.	0.6964	6.64
1.77	4.69	1.59	132.	0.6610	6.99
1.73	4.75	1.60	132.	0.6632	7.00
1.76	4.77	1.65	139.	0.6541	6.87
1.76	4.74	1.65	138.	0.6519	6.87
1.81	5.44	1.94	190.	0.6434	7.40
1.77	5.77	2.16	221.	0.6256	7.63
1.79	5.70	2.18	223.	0.6175	7.65
1.76	5.64	2.23	221.	0.6046	7.52
1.76	5.62	2.23	220.	0.6032	7.52
1.78	5.78	2.31	238.	0.6003	7.77
1.80	6.03	2.45	267.	0.5937	7.95
1.79	6.07	2.59	282.	0.5733	8.08
1.77	6.25	2.67	294.	0.5728	8.03
1.77	6.04	2.69	288.	0.5546	8.03
1.78	6.13	2.86	311.	0.5334	8.33
1.77	6.12	2.86	211.	0.5327	8.33

CARBON (GRAPHITE POROUS)

RHOO	US	UP	P	V/VO	US(ST)
1.75	6.20	2.88	312.	0.5355	8.34
1.78	6.23	2.89	320.	0.5361	8.37
1.75	6.32	2.94	325.	0.5348	8.42
1.75	6.28	3.08	338.	0.5096	8.54
1.77	6.69	3.12	370.	0.5336	8.54
1.77	6.61	3.13	367.	0.5265	8.54
1.79	6.72	3.27	394.	0.5134	8.80
1.81	6.78	3.35	411.	0.5059	8.89
1.76	6.53	3.40	390.	0.4793	8.79
1.76	6.49	3.40	388.	0.4761	8.79
1.76	7.14	3.60	453.	0.4958	9.14
1.79	7.17	3.68	472.	0.4868	9.24
1.76	7.24	3.78	481.	0.4779	9.33
1.76	7.90	4.12	574.	0.4785	9.74
1.76	8.15	4.14	593.	0.4920	9.79
1.74	8.09	4.21	592.	0.4796	9.84
1.75	8.28	4.24	615.	0.4879	9.90
1.74	8.39	4.45	651.	0.4696	10.11
1.74	8.45	4.46	655.	0.4722	10.13
1.75	8.82	4.65	720.	0.4728	10.38
1.76	9.10	4.76	763.	0.4769	10.53

US = 1.68 + 1.90*UP KM/SEC .9<UP<2.18
SIG US = 0.20 KM/SEC
US = 1.70 + 1.51*UP KM/SEC 3.06<UP<5.
SIG US = 0.5 KM/SEC

TABLE VI

- - - - - - - - - SAMPLE	- - - - - - -				STANDARD
RHOO	US	UP	P	V/VO	US(ST)
1.54	2.76	0.96	41.	0.6522	6.26
1.56	4.39	1.75	119.	0.6014	7.05
1.55	4.31	1.76	117.	0.5916	7.05
1.55	5.25	2.34	190.	0.5543	7.66
1.54	5.24	2.34	190.	0.5534	7.66
1.54	5.27	2.38	194.	0.5484	7.69
1.55	6.17	3.20	307.	0.4814	8.54
1.54	6.16	3.21	304.	0.4789	8.54
1.55	6.24	3.41	329.	0.4535	8.73
1.54	6.25	3.41	328.	0.4544	8.73
1.53	7.29	4.28	476.	0.4129	9.64
1.52	7.22	4.29	471.	0.4058	9.64

US = 0.842 + 2.00*UP KM/SEC 0.9<UP<2.15
SIG US = 0.25 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.

HUGONIOTS OF GRAPHITES OF VARIOUS INITIAL DENSITIES AND THE
EQUATION OF STATE OF CARBON
SYMPOSIUM ON THE 'BEHAVIOR OF DENSE MEDIA UNDER
HIGH DYNAMIC PRESSURE', I.U.T.A.M, PARIS, 1967
(GORDON AND BREACH, N.Y. 1968)

2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION METHOD B.
STANDARD MATERIAL 2024 ALUMINUM WITH LINEAR SHOCK VELOCITY-PARTICLE
VELOCITY HUGONIOT RELATIONSHIP US=5.46+1.318*UP KM/SEC,
RHO0=2.785 G/CC, GRUNEISEN GAMMA = 1.89

3) THE VALUE OF V01 WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS:
A = 2.4612 ANGSTROMS, C = 6.7079 ANGSTROMS, A.C.A. MONOGRAPH NO.5
AMERICAN CRYSTALLOGRAPHIC ASSOCIATION (1963).

4) THE ABOVE DATA WERE DISCUSSED BY R. G. MCQUEEN IN METALLURGICAL
SOCIETY CONFERENCES, (GORDON AND BREACH SCIENCE PUBLISHERS N. Y. 1963
VOL. 22, CHAPTER 3.

5) MATERIAL OF TABLE I PRESSED GRAPHITE
\- - - II PRESSED GRAPHITE
\- - - III UNION CARBIDE CO. GRADE ZTA: HOT WORKED GRAPHITIZED TAR (99.8 WT. PERCENT C)
\- - - IV PRESSED GRAPHITE
\- - - V UNION CARBIDE CO. GRADE ATJ: GRAPHITIZED TAR (99.8 PERCENT C)
\- - - VI UNION CARBIDE CO. GRADE PT 0178: CELLULOSE FIBRE MIXTURE.

TABLE I

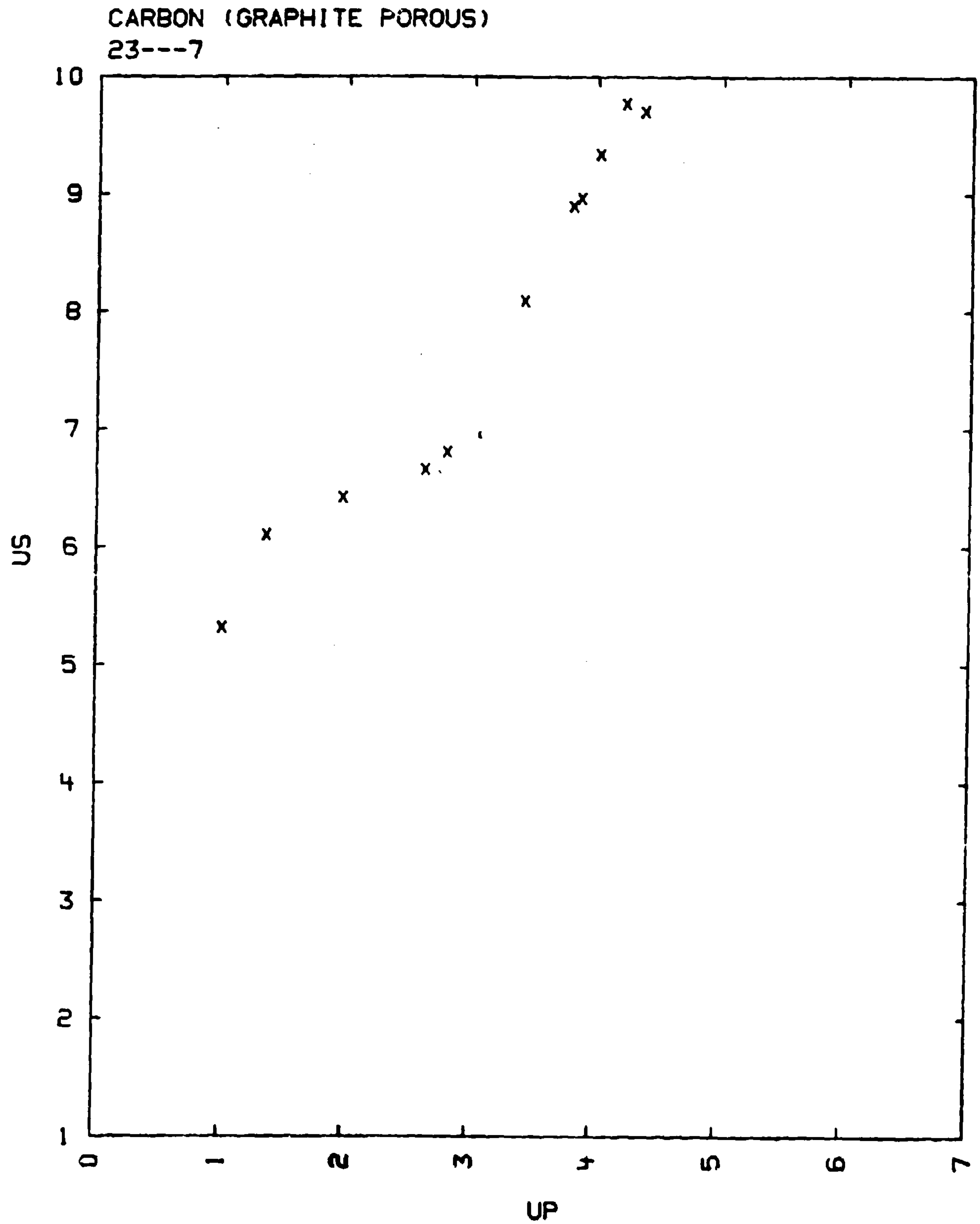


TABLE II

CARBON (GRAPHITE POROUS)
23---7

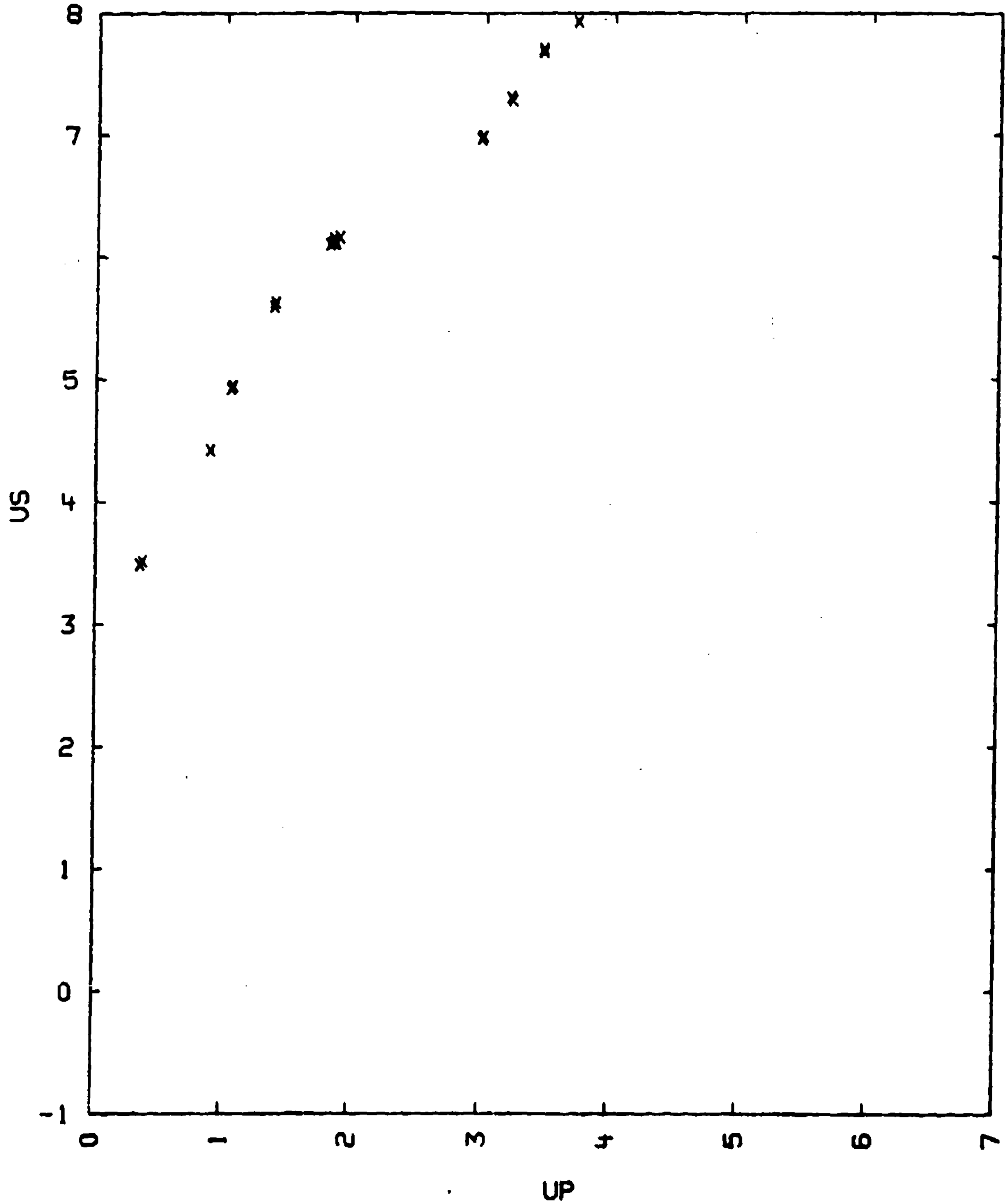


TABLE III

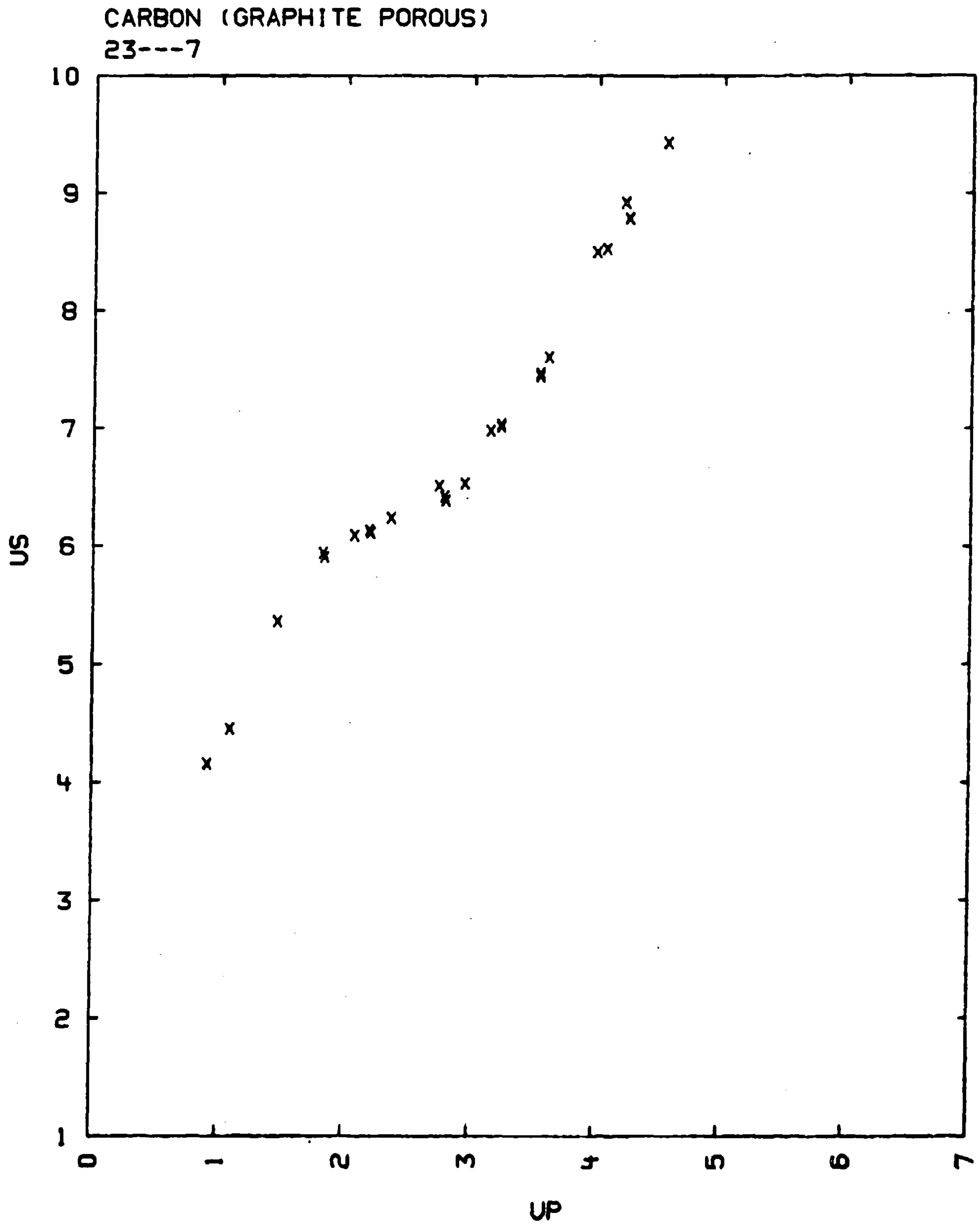


TABLE IV

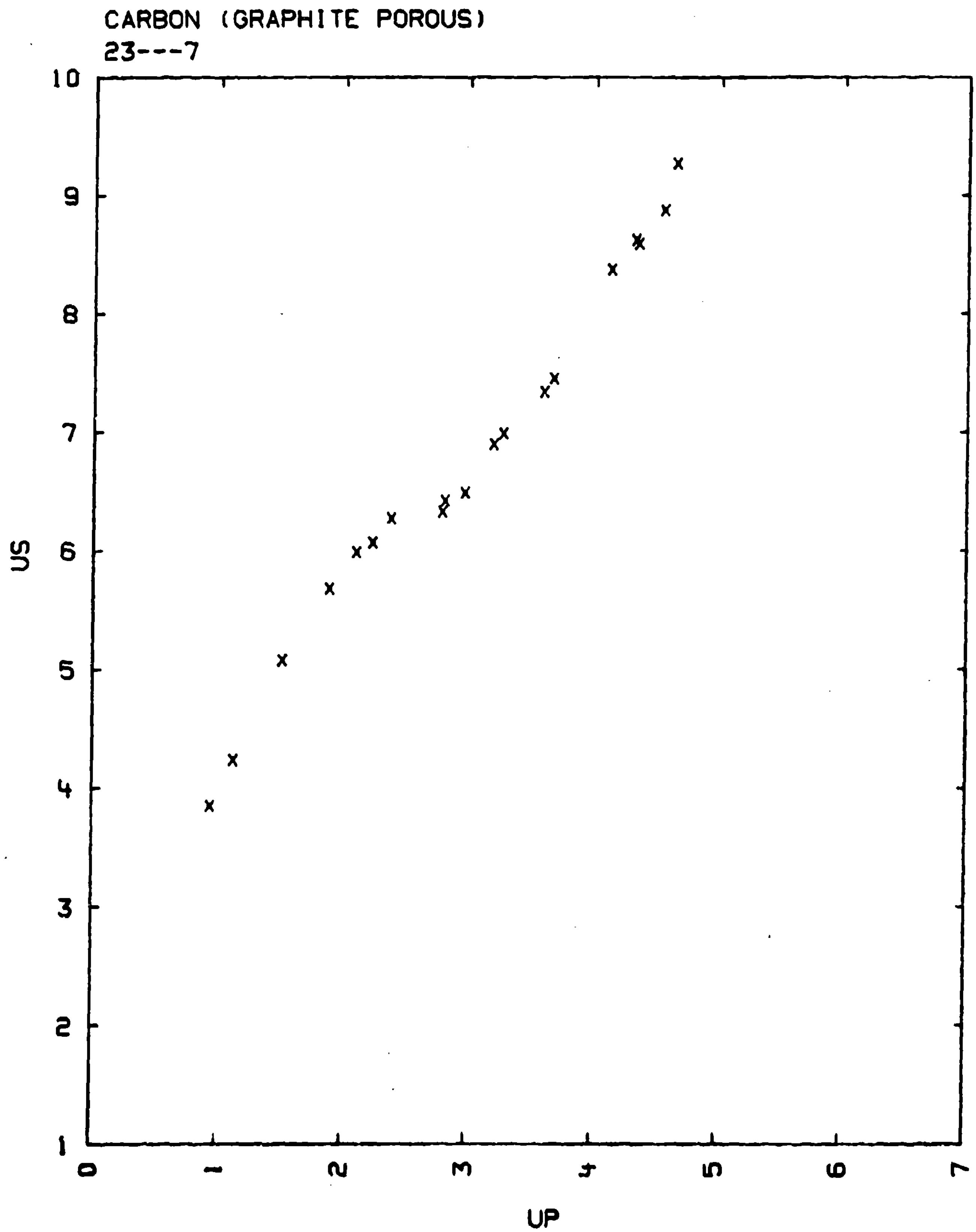


TABLE V

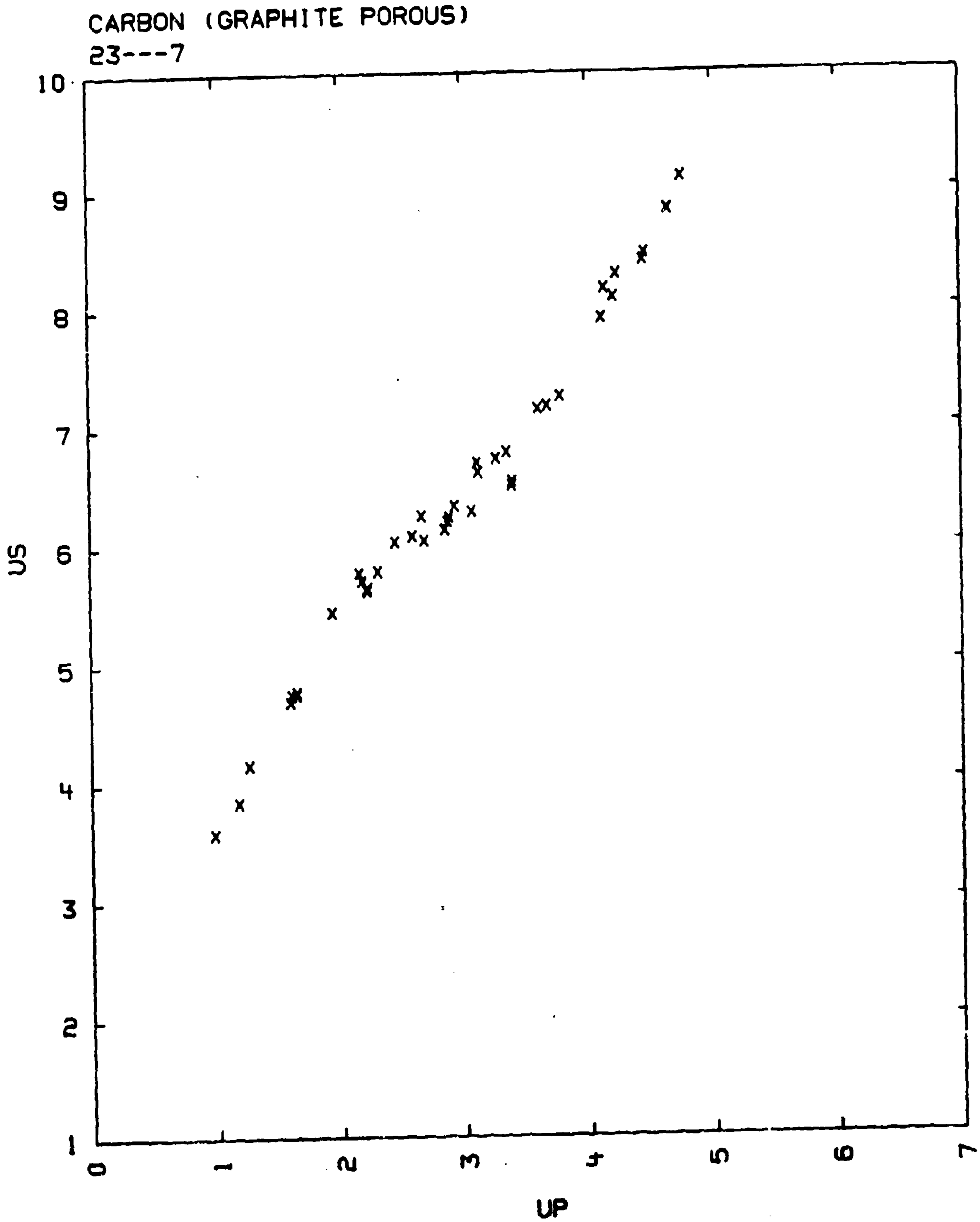
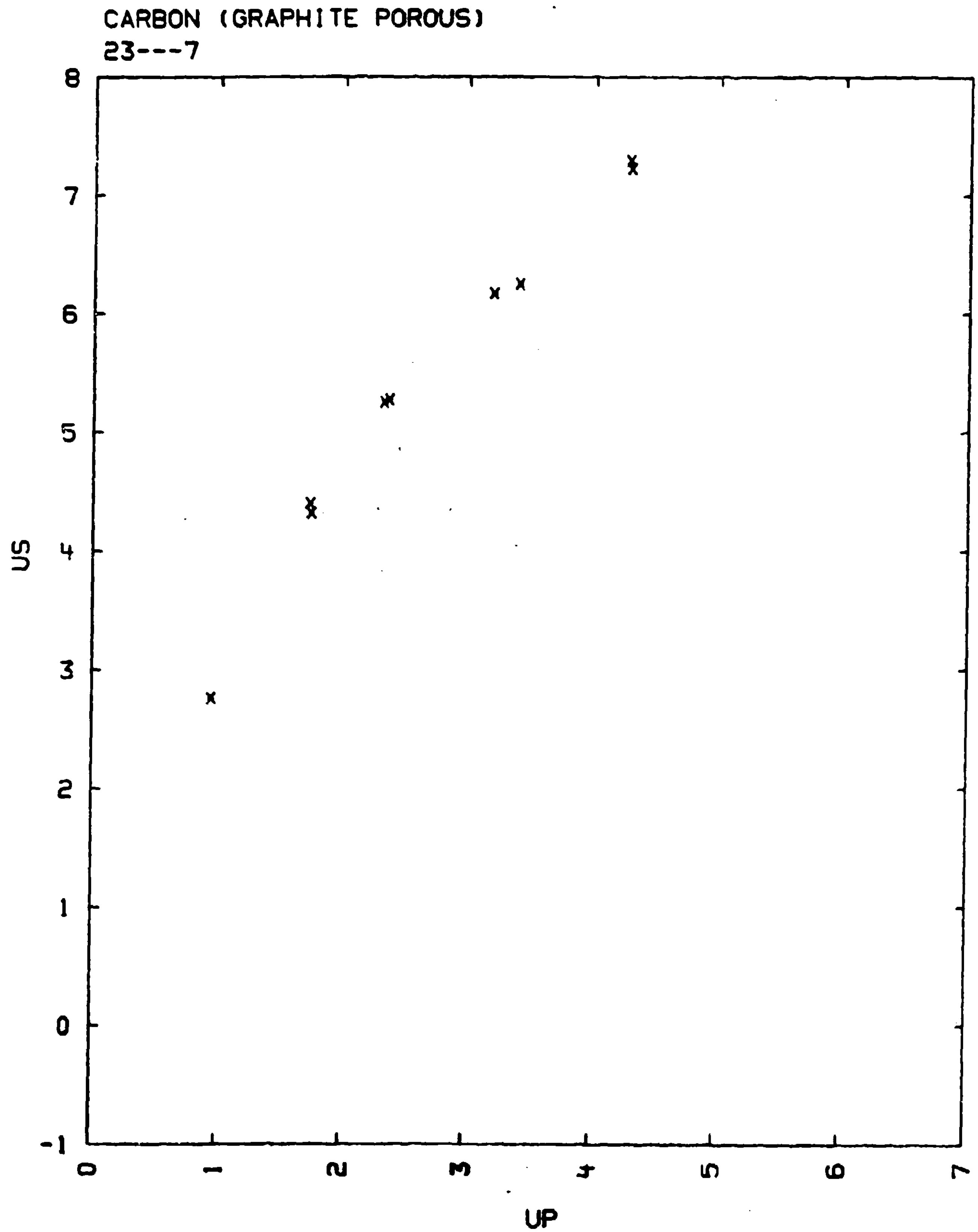


TABLE VI



23---8
CARBON (DIAMOND PRESSED)

C:		99+	WT. PERCENT.	
DIAMOND	95		-	-
GRAPHITE	5		-	-
POROSITY	6		VOL.	-

VO = 0.314 CC/G   CO = 11.22 KM/SEC
VOI = 0.284404 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

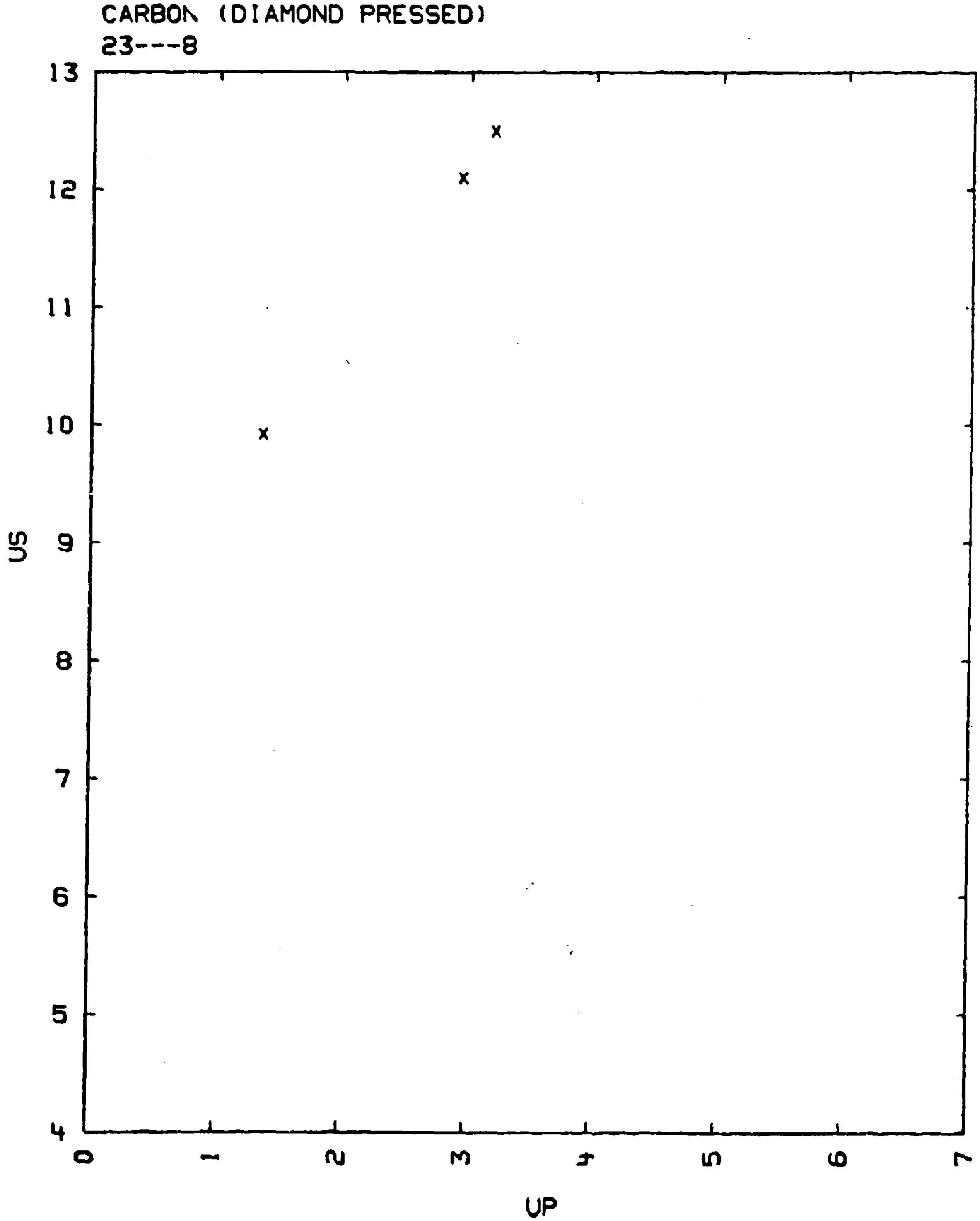
SAMPLE					STANDARD
RHOO	US	UP	P	V/VO	US(ST)
3.20	9.91	1.37	434.	0.8618	7.65
3.17	12.10	2.94	1128.	0.7570	9.93
3.20	12.49	3.19	1275.	0.7446	10.31

US = 7.976 + 1.409*UP KM/SEC
SIG US = 0.027 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
HUGONIOTS OF GRAPHITES OF VARIOUS INITIAL DENSITIES AND THE EQUATION OF STATE OF CARBON
IVTAM SYMPOSIUM: BEHAVIOR OF DENSE MEDIA UNDER HIGH DYNAMIC PRESSURES. (PARIS '67) (GORDON AND BREACH, NEW YORK 1968)
2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION METHOD B.
STANDARD MATERIAL 2024 ALUMINUM WITH LINEAR SHOCK VELOCITY-PARTICLE VELOCITY HUGONIOT RELATIONSHIP US=5.46+1.318*UP KM/SEC, RHOO=2.785 G/CC, GRUNEISEN GAMMA = 1.89
3) THE VALUE OF VOI WAS OBTAINED FROM WYCKOFF, CRYSTAL STRUCTURES, (INTERSCIENCE PUBL., N. Y. 1963) 2ND ED. VOL. 1: A = 3.56679 ANGSTR.
4) THE DIAMOND SAMPLES WERE PRESSED WITH GRAPHITE BINDER (CIRCA 5 WT. PERCENT) INTO 9 TO 12 MM DIAMETER DISCS.
5) CO =(((C11)+2(C12))/(3*RHOO))**0.5 WITH C11 = 10.79 +- 0.05 MBAR
T = 25 DEG. C., RHOO = 3.512 G/CC., C12 = 1.24 +- 0.05 -
H.J. MCSKIMMIN AND P. ANDREATCH,JR. PHYS. REV. 43, 2944 (1972)

TABLE I



25---1
GERMANIUM

GE

VO = 0.1885 CC/G
VOI = 0.1878 CC/G

CO = 3.77 KM/SEC
CB = 3.82 KM/SEC

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN KM/SEC, AND PRESSURE IN KILOBARS.

TABLE

SAMPLE						BASE PLATE
RHOO	US	UFS	UP	P	V/VO	PRESSURE
5.324	3.81	1.32	0.73	148	0.808	139
5.317	4.43	2.93	1.63	384	0.632	363
5.239	4.38	2.84	1.56	358	0.645	341
5.308	3.87	1.75	0.97	199	0.749	192
5.327	4.71	3.25	1.72	430	0.635	398
5.312	5.82	4.54	2.34	723	0.598	632
5.317	6.28	5.12	2.62	875	0.583	756

US = 1.52 + 1.83 UP KM/SEC (FOR UP FROM 1.56 TO 2.62 KM/SEC)

SIGMA US = 0.053 KM/SEC

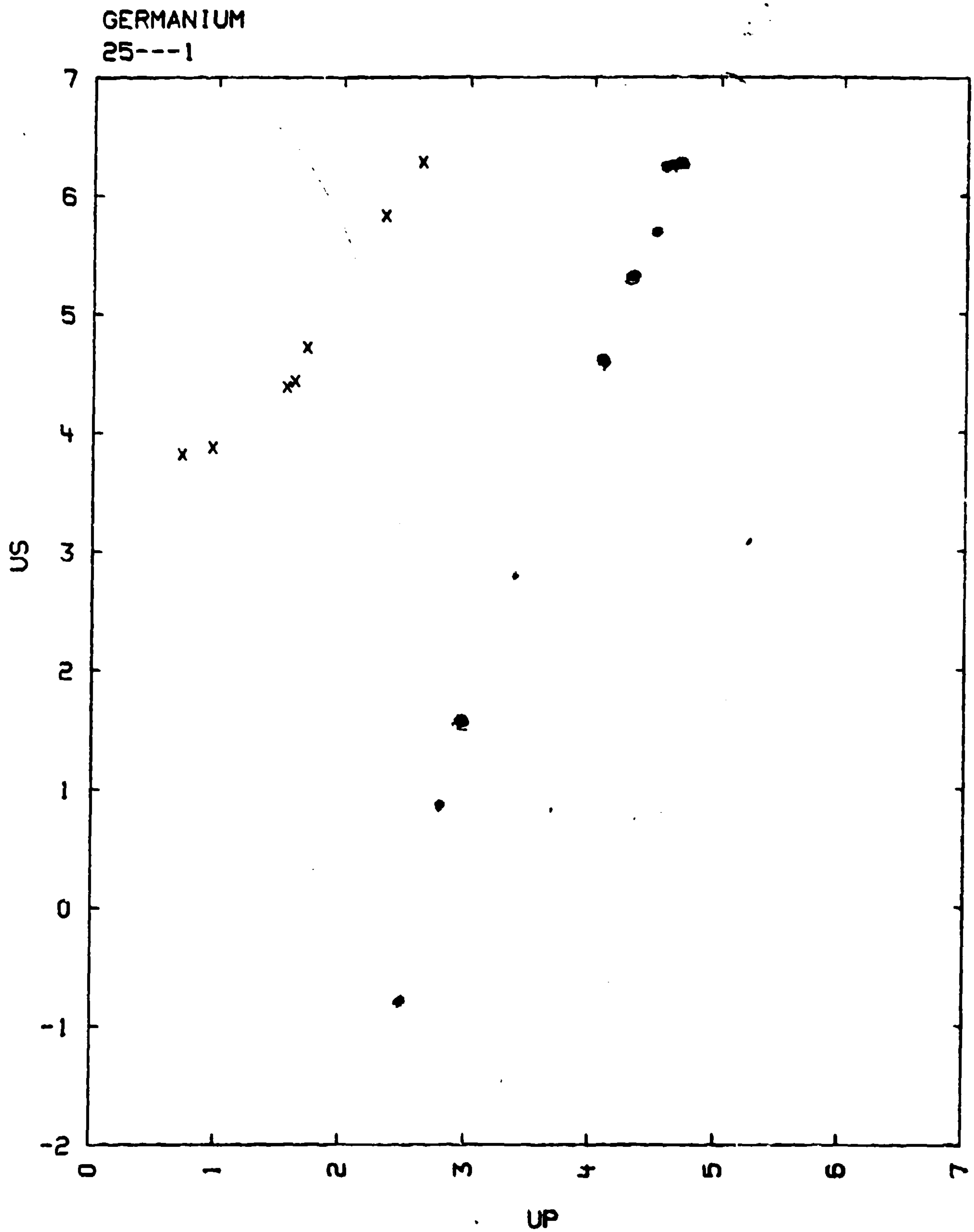
COMMENTS:

1) SOURCE: COMPILER
L.R.L. EQUATION OF STATE FILE
LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIFORNIA.
2) EXPERIMENTAL TECHNIQUE B. (ALUMINUM STANDARD BASE PLATE).
DATA REDUCTION TECHNIQUE B.
3) THE VALUE OF VOI WAS OBTAINED FROM A. TAYLOR AND BRENDA J. KAGLE, CHRISTALLOGRAPHIC DATA ON METAL AND ALLOY STRUCTURES (DOVER PUBLICATIONS, INC., NEW YORK, N. Y., 1963).
4) THE VALUE OF CO WAS CALCULATED FROM DATA LISTED BY H. L. BOND ET AL. ELASTIC CONSTANTS OF GERMANIUM SINGLE CRYSTALS PHYS. REV. LETTERS VOL. 78 P. 176 (1950).
THE FOLLOWING CONSTANTS WERE LISTED:
C11 = 1.298 MEGABARS
C12 = 0.488 -
C44 = 0.673 -
5) A DYNAMIC YIELD POINT AT P = 46 KBAR, V/VO = 0.975 AND A DYNAMIC TRANSITION POINT AT P = 140 KBAR, V/VO = 0.875 HAS BEEN OBSERVED BY R. A. GRAHAM ET AL., SANDIA CORPORATION, ALBUQUERQUE, NEW MEXICO (PREPRINT).
PREVIOUS WORK SUGGESTS THAT THE UPPER TRANSITION IS DUE TO MELTING: TO 180,000 ATMOSPHERES, J. PHYS. CHEM. VOL. 59 P. 1144 (1955) OR A SOLID-SOLID TRANSITION NEAR THE MELTING POINT REPORTED BY S. MINOMURA AND H. G. DRICKAMER, PRESSURE INDUCED PHASE TRANSITION

IN SILICON, GERMANIUM AND SOME III-V COMPOUNDS, J. PHYS. CHEM. SOLIDS, VOL. 23 P. 451 (1962), IS NOT CLEAR.

6) THE EXTRAPOLATED V/VO OF THE TABLE SUGGESTS THAT THE VOLUME CHANGE ACCOMPANYING THE UPPER TRANSITION OR TRANSITIONS IS OVER 10 PERCENT.

TABLE I



25---2
GERMANIUM, SINGLE CRYSTAL.

GE

V0 = 0.1869 CC/G
V01 = 0.1878 CC/G

IN TABLE I BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN KM/SEC, AND (*) INDICATES ASSUMED VALUES. IN TABLE II, PRESSURES ARE GIVEN IN KILOBARS.

TABLE I

RHO0	US1	UP1	US2	UP2	US3	UP3
5.35	5.63	0.0775				
5.35	5.78	0.1286				
5.35	5.71	0.1443*	3.43	0.1580		
5.35	5.79	0.1443*	3.41	0.1620		
5.35	5.75	0.1443*	3.58	0.1700		
5.35	5.75	0.1443*	3.54	0.2132		
5.35	5.78	0.1443*	3.63	0.3432		
5.35	5.79	0.1443*	4.13	0.5540		
5.35	5.79	0.1443*	4.26	0.5778*	1.17	0.6015

US = 3.16 + 1.79*UP +OR- 0.09 KM/SEC

TABLE II

P1	V1/V0	P2	V2/V0	P3	V3/V0
23.3	0.9864				
39.8	0.9778				
44	0.9750	46.5	0.9705		
44	0.9751	49.0	0.9697		
44	0.9749	50.3	0.9675		
44	0.9749	58.3	0.9551		
44	0.9750	83.5	0.9193		
44	0.9751	136.	0.8748		
44	0.9751	140. *	0.8724	142	0.8413

COMMENTS:

1) SOURCE: GRAHAM, R. A., JONES, O. E. AND HOLLAND, J. R.
JOURNAL OF PHYSICS AND CHEMISTRY OF SOLIDS, VOL. 27, P 1519 (1966).
2) EXPERIMENTAL TECHNIQUE A: SHOCK VELOCITY WAS DETERMINED FROM THE DEPENDENCE OF CONDUCTIVITY ON TIME DURING SHOCK TRANSIT. PROJECTILE VELOCITY WAS

DETERMINED WITH SHEAR PINS.

DATA REDUCTION TECHNIQUE A
STANDARD MATERIAL GERMANIUM, ASSUMING UFS = 2UP.

3) THE GERMANIUM CRYSTALS WERE HIGH PURITY, N-TYPE.
4) THE CRYSTALS WERE ORIENTED WITH THEIR FACES PARALLEL TO A (111) CRYSTAL PLANE.
5) THE GERMANIUM PROJECTILES WERE ACCELERATED BY MEANS OF A COMPRESSED GAS GUN. THE ANGULAR MISALIGNMENT BETWEEN THE IMPACTING SURFACES IS APPROXIMATELY 0.0005 RADIANS.
6) FOR PARTICLE VELOCITY (UP) LESS THAN 0.1286 KM/SEC A SINGLE WAVE IS OBSERVED AND AT UP = 0.1580 KM/SEC TWO WAVES ARE OBSERVED. WHEN UP = 0.6015 KM/SEC A THIRD WAVE APPEARS. THE ASSUMED VALUES OF (UP) FOR THE FIRST AND SECOND WAVES ARE 0.1443 AND 0.5778 KM/SEC RESPECTIVELY. THE TRANSITION PRESSURES 44 AND 140 KILOBARS ARE PROBABLY ACCURATE TO +OR- 10 PERCENT.
7) V0I WAS OBTAINED FROM A. TAYLOR AND BRENDA J. KAGLE, CHRISTALLOGRAPHIC DATA ON METAL AND ALLOY STRUCTURES (DOVER PUBLICATIONS, INC., NEW YORK, N. Y., 1963).

TABLE I

GERMANIUM, SINGLE CRYSTAL.
25---2

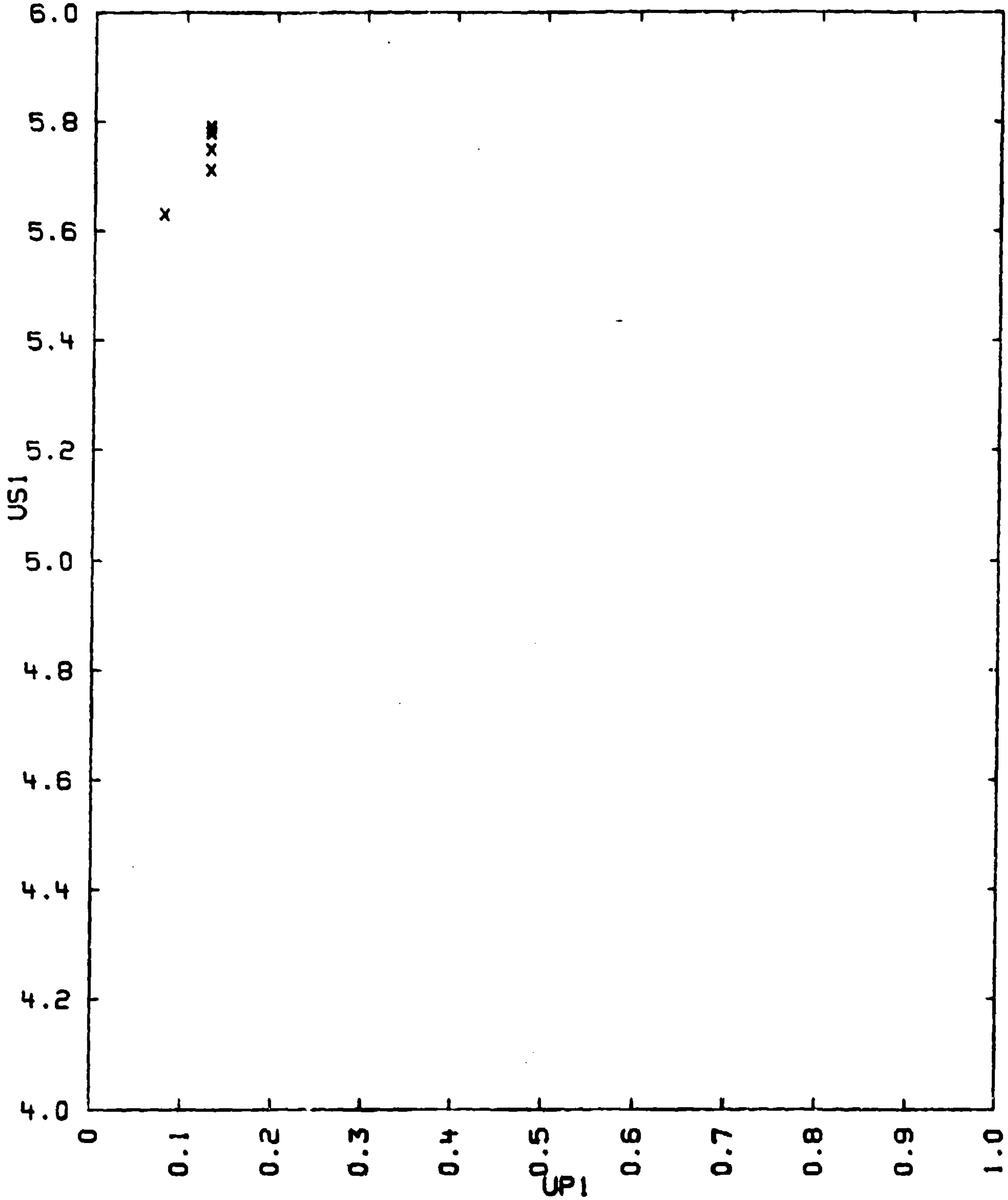


TABLE I

GERMANIUM, SINGLE CRYSTAL.
25---2

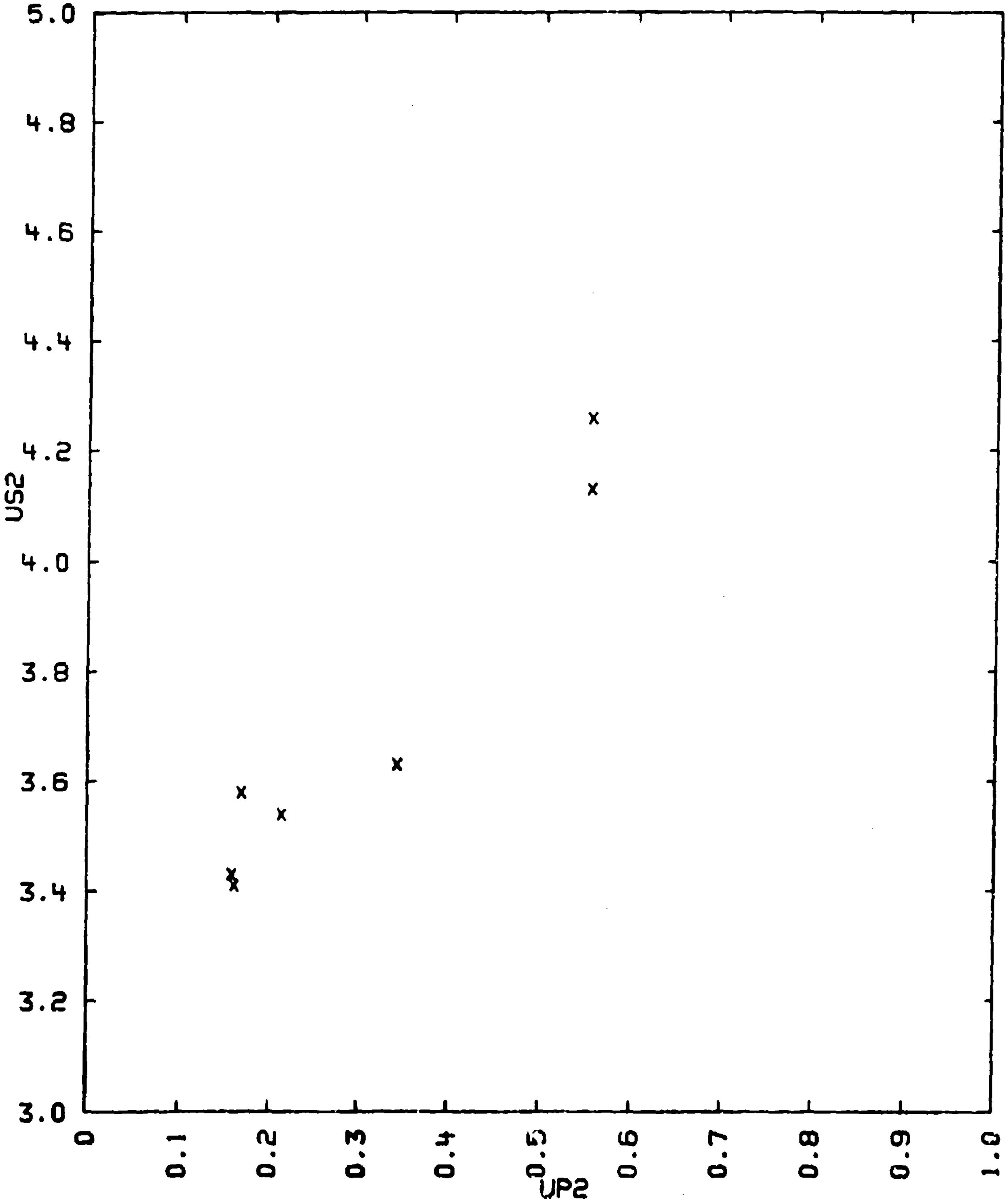
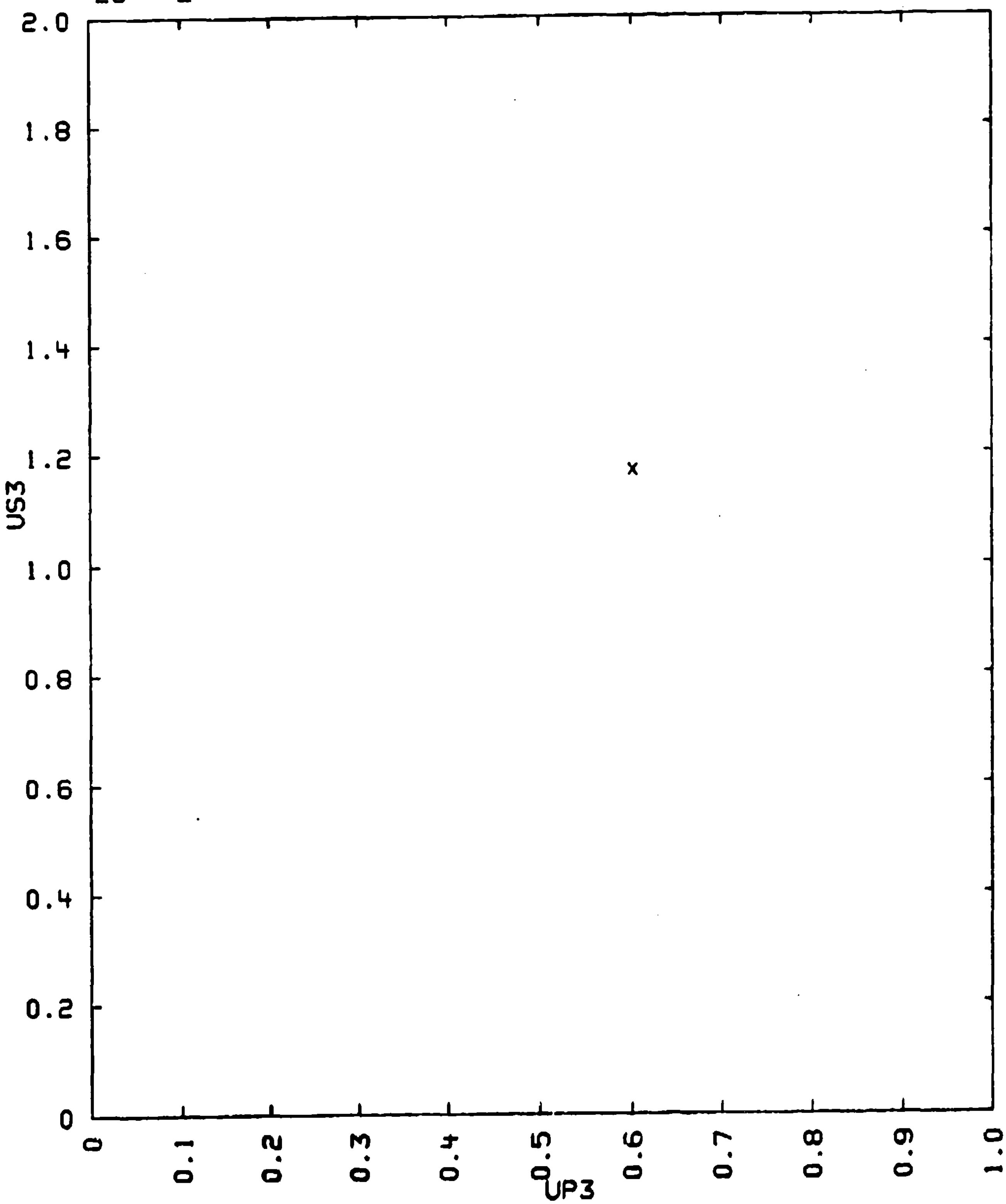


TABLE I

GERMANIUM, SINGLE CRYSTAL.
25---2



25---3
GERMANIUM

GE

V0 = 0.1878 CC/G
V01 = 0.1879 CC/G

C0 = 3.754 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
5.330	4.25	0.60	136.	0.8588	2024 AL	6.24
5.330	4.22	0.75	169.	0.8223	2024 AL	6.45
5.311	4.25	0.75	168.	0.8235	2024 AL	6.46
5.311	4.14	0.79	174.	0.8092	2024 AL	6.49
5.330	4.19	1.05	234.	0.7494	2024 AL	6.84
5.330	4.16	1.07	237.	0.7428	2024 AL	6.86
5.330	4.09	1.07	233.	0.7384	2024 AL	6.86
5.311	4.12	1.09	239.	0.7354	2024 AL	6.87
5.330	4.17	1.23	273.	0.7050	2024 AL	7.06
5.311	4.18	1.46	324.	0.6507	2024 AL	7.36
5.311	4.30	1.47	336.	0.6581	2024 AL	7.38
5.311	4.18	1.50	333.	0.6411	2024 AL	7.40
5.330	4.57	1.59	387.	0.6521	2024 AL	7.60
5.330	4.55	1.60	388.	0.6484	2024 AL	7.60
5.330	4.49	1.61	385.	0.6414	2024 AL	7.61
5.330	4.82	1.75	450.	0.6369	2024 AL	7.85
5.330	4.91	1.79	468.	0.6354	2024 AL	7.92
5.330	5.22	1.95	543.	0.6264	2024 AL	8.17
5.330	5.22	1.96	545.	0.6245	2024 AL	8.19
5.330	5.14	1.97	540.	0.6167	2024 AL	8.19
5.330	5.45	2.09	607.	0.6165	2024 AL	8.41
5.330	5.38	2.11	605.	0.6078	2024 AL	8.41
5.330	5.77	2.15	661.	0.6274	2024 AL	8.55
5.330	5.68	2.16	654.	0.6197	2024 AL	8.55
5.330	5.72	2.16	659.	0.6224	2024 AL	8.55
5.330	5.73	2.19	669.	0.6178	2024 AL	8.59
5.330	5.72	2.24	683.	0.6084	2024 AL	8.66
5.330	5.50	2.25	660.	0.5909	2024 AL	8.61
5.330	5.39	2.27	652.	0.5788	2024 AL	8.61
5.330	5.65	2.27	684.	0.5982	2024 AL	8.68
5.330	6.07	2.40	776.	0.6046	2024 AL	8.93
5.330	6.12	2.41	786.	0.6062	2024 AL	8.96
5.330	5.97	2.64	840.	0.5578	2024 AL	8.99
5.330	5.91	2.47	778.	0.5821	2024 AL	8.99
5.330	6.16	2.48	814.	0.5974	2024 AL	9.05
5.330	6.06	2.56	827.	0.5776	2024 AL	9.13
5.330	6.20	2.56	846.	0.5871	2024 AL	9.17
5.330	6.19	2.57	848.	0.5849	2024 AL	9.17
5.330	6.10	2.58	839.	0.5770	2024 AL	9.16

GERMANIUM

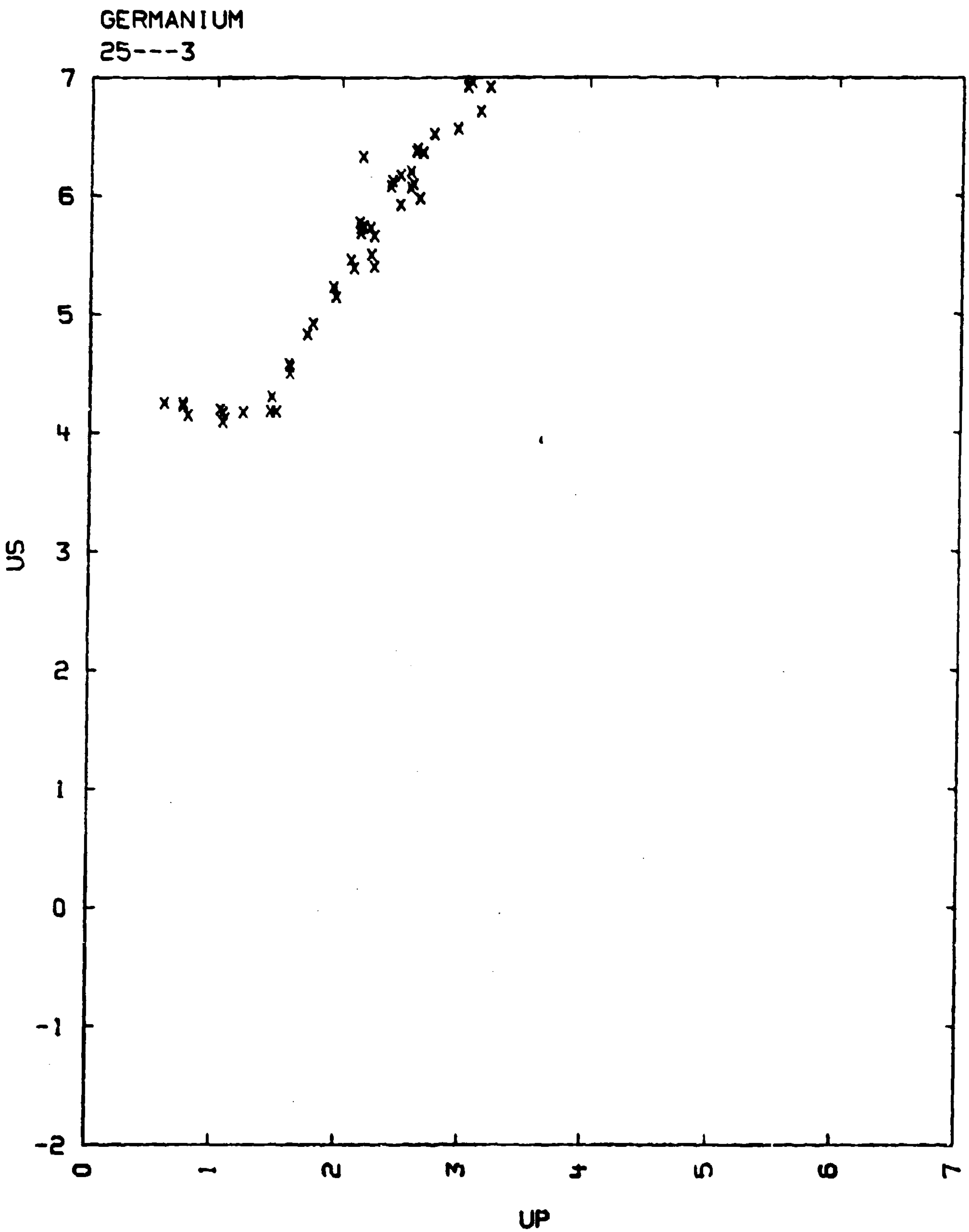
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
5.330	6.37	2.60	883.	0.5918	2024 AL	9.25
5.330	6.39	2.61	889.	0.5915	2024 AL	9.27
5.330	6.36	2.66	902.	0.5818	2024 AL	9.32
5.330	6.32	2.17	731.	0.6566	2024 AL	9.37
5.330	6.52	2.74	952.	0.5798	2024 AL	9.46
5.330	6.56	2.94	1028.	0.5518	2024 AL	9.72
5.330	6.92	3.01	1110.	0.5650	2024 AL	9.89
5.330	6.96	3.04	1128.	0.5632	2024 AL	9.94
5.330	6.71	3.12	1116.	0.5350	2024 AL	9.98
5.330	6.91	3.19	1175.	0.5384	2024 AL	10.11

US = 0.264 + 3.27*UP - 0.371*UP**2 KM/SEC FOR UP ABOVE 1.5 KM/SEC
SIG US = 0.19 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES, HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII
2) EXPERIMENTAL TECHNIQUE: B
DATA REDUCTION TECHNIQUE: B
3) VOI FROM WYCKOFF, CRYSTAL STRUCTURES (JOHN WILEY, N.Y., 1963) VOL 1.
4) CO WAS CALCULATED FROM C11 = 12.8528E+11 DYNES/CM**2
C12 = 4.82595E+11 DYNES/CM**2
C44 = 6.680E+11 DYNES/CM**2
MC SKIMIN AND ANDREATCH, J. APL. PHYS. V. 34, P. 651, (1963).
5) HUGONIOT ELASTIC LIMIT 52., 40., 37. KBAR (100, 114, 111 DIRECTIONS)

TABLE I



26---0
TIN SUMMARY

SN 99.8 PERCENT

V0 = 0.1374 CC/G
V0I= 0.1372 CC/G

C0 = 2.674 KM/SEC
CB = 2.76 KM/SEC

THE TABLE BELOW LISTS THE HUGONIOT POINTS CALCULATED FROM THE US VS UP FITS GIVEN. VELOCITIES ARE IN KM/SEC, DENSITY IN G/CC, PRESSURE IN KBAR AND ENERGY DIFFERENCE IN KBAR.CC/G.

TABLE

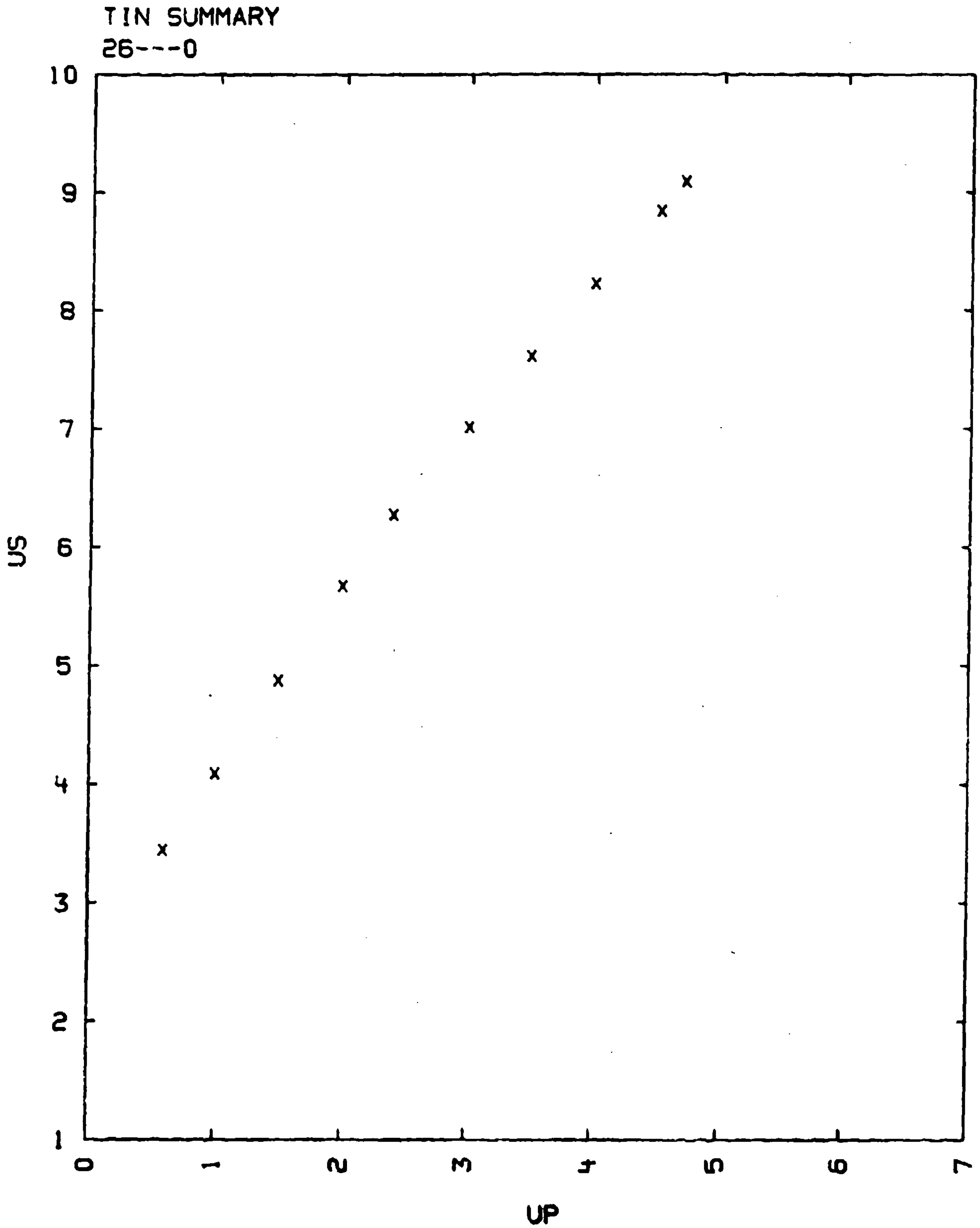
FIT	RHOO	US	UP	P	V/V0	E-E0
1	7.28	3.44	0.6	150	0.826	1.80
1	-	4.08	1.0	297	0.755	5.00
1	-	4.87	1.5	532	0.692	11.25
1	-	5.67	2.0	825	0.647	20.0
2	-	6.27	2.4	1096	0.618	28.8
2	-	7.01	3.0	1530	0.572	45.0
2	-	7.61	3.5	1940	0.540	61.2
2	-	8.22	4.0	2395	0.514	80.0
2	-	8.83	4.5	2894	0.491	101.2
2	-	9.08	4.7	3106	0.482	110.5

US = 2.49 + 1.59*UP, SIG.US = 0.04 KM/SEC (FIT 1)
FOR UP BETWEEN 0.6 AND 2.2 KM/SEC
US = 3.35 + 1.219*UP, SIG.US = 0.05 KM/SEC (FIT 2)
FOR UP BETWEEN 2.2 AND 4.7 KM/SEC

COMMENTS:

1) SOURCE: COMPILER.
1A) THE DATA OF MATERIALS 26---1,2 AND 3 WERE USED FOR THIS SUMMARY. THE DATA OF 26---3 TABLE II AND 26---4 AGREE WITH THE OTHER DATA BUT DO NOT IMPROVE THE ACCURACY.
2) THE CRYSTAL DENSITY WAS OBTAINED FROM THE AM. INST. OF PHYS. HANDBOOK (MCGRAW-HILL BOOK CO INC. 1963) 2ND. ED.
3) C0 AND CB ARE VALUES USED ON PAGES 26---2 AND 3.

TABLE I



26---1
TIN

SN 99.8 PER CENT OR GREATER

VO = 0.1374 CC/G. CL = 3.32 KM/SEC. CO = 2.70 KM/SEC.
VOI = 0.1370 CC/G. CS = 1.67 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURE IN KILOBARS, AND DENSITY IN G/CC.

TABLE

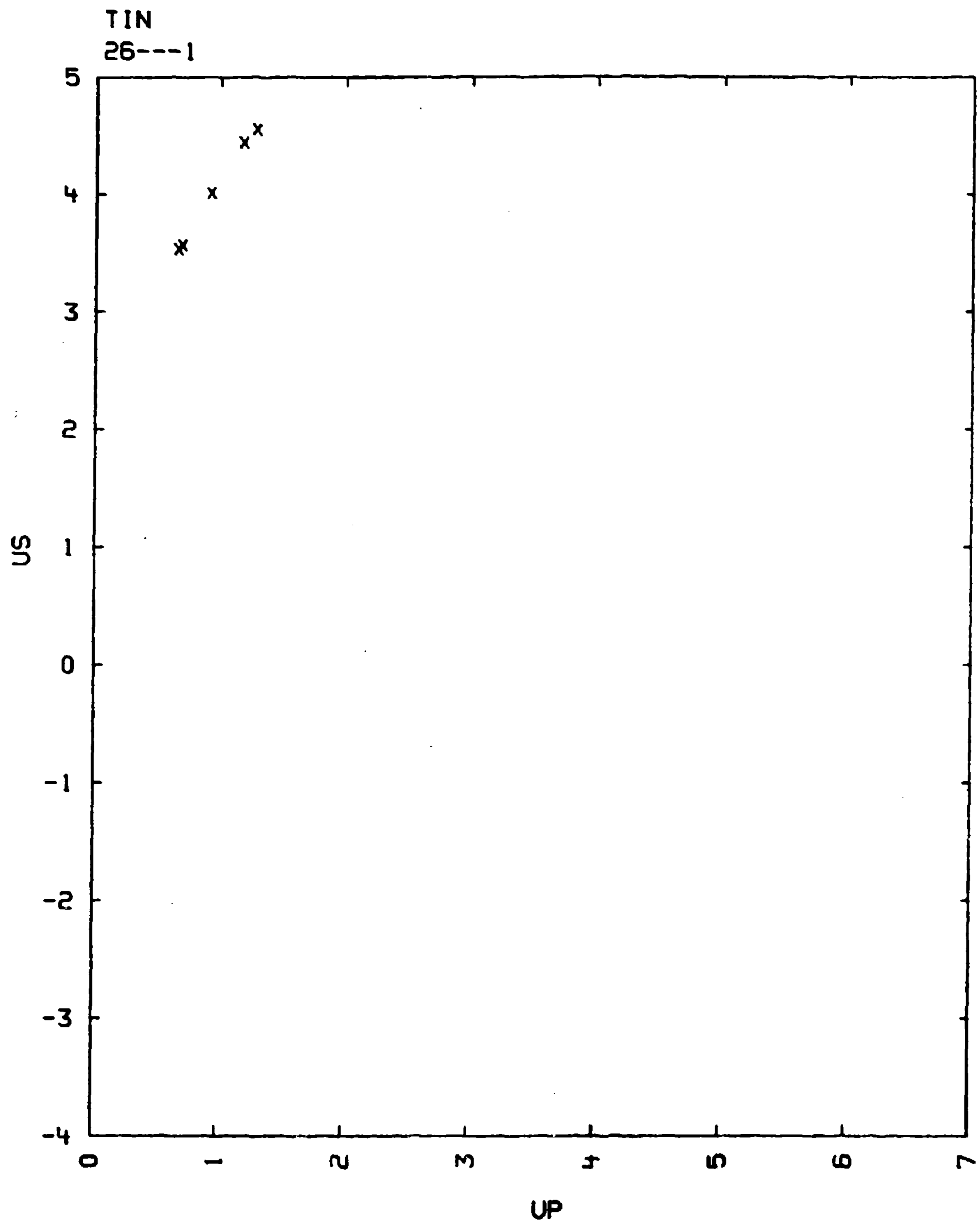
RHOO	US	UFS	UP	P	V/VO
7.28	4.555	2.704	1.290	427.8	0.7168
-	4.435	2.539	1.190	384.2	0.7317
-	4.004	1.912	0.925	269.6	0.7690
-	3.557	1.486	0.705	182.6	0.8018
-	3.524	1.364	0.670	171.9	0.8098

US = 2.378 + 1.712 UP KM/SEC SIGMA US = 0.9 PERCENT

COMMENTS:

1) SOURCE: WALSH, J. M., RICE, M. H., MCQUEEN, R. G. AND YARGER, F. L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 1 PER CENT IN COMPRESSION AT A GIVEN PRESSURE.
4) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS
5) CL AND CS WERE OBTAINED FROM L. BERGMAN, DE ULTRSCHALL, S. HIRZEL VERLAG, STUTTGART, 1954, 6TH ED., P. 650
6) VOI WAS TAKEN FROM THE A. I. P. HANDBOOK (MCGRAW HILL BOOK CO.) 2ND ED.

TABLE I



26---2
TIN

SN

V0 = 0.1374 CC/G
V01= 0.1372 CC/G

CB = 2.76 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC.,
PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

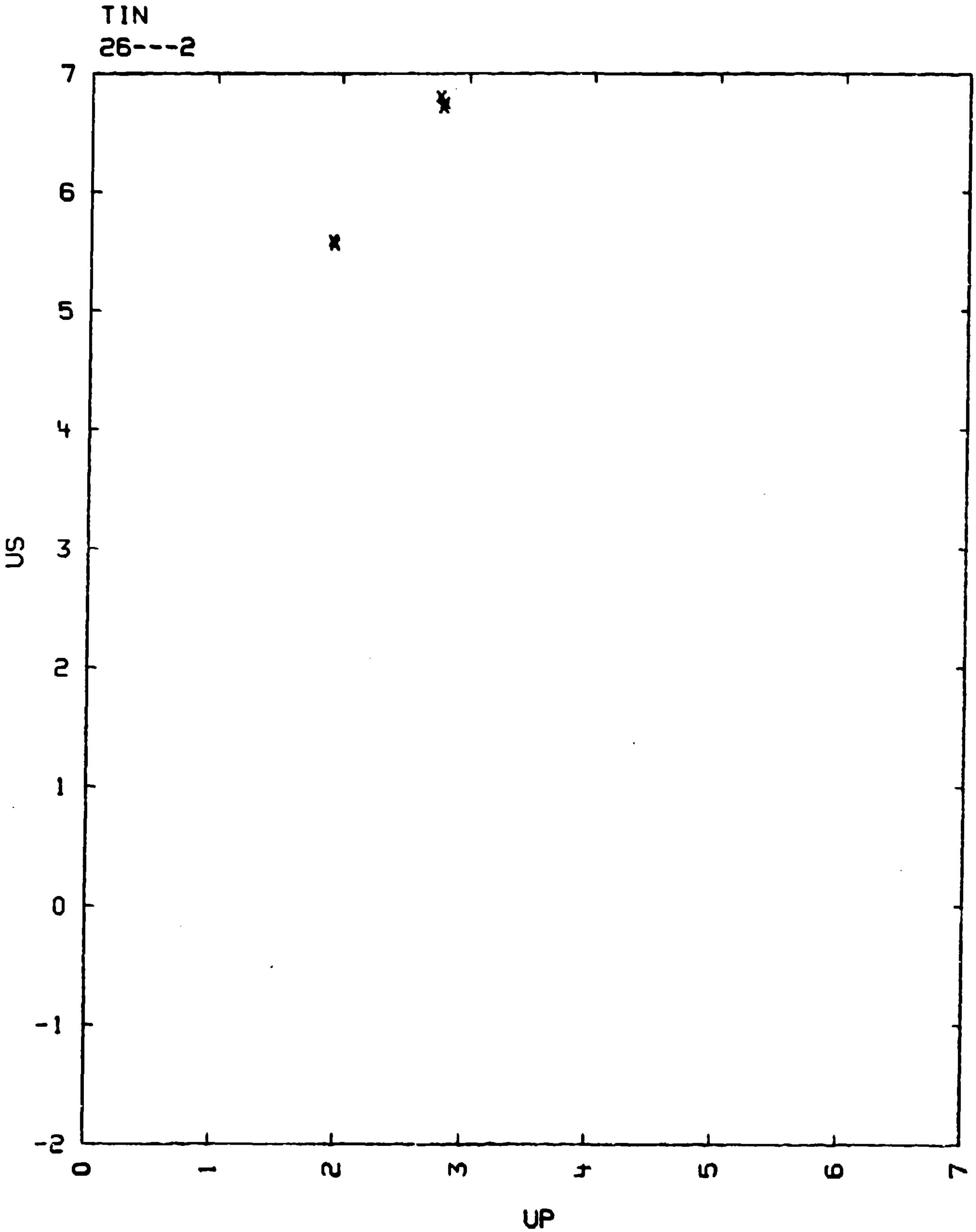
RHO0	US	UP	P	V/V0	PRESSURE IN BRASS STANDARD
7.28	5.59	1.94	792	0.652	931
-	5.55	1.95	788	0.648	931
-	5.57	1.95	790	0.651	931
-	6.71	2.80	1364	0.583	1586
-	6.80	2.78	1377	0.591	1587
-	6.75	2.81	1378	0.584	1599

US = 2.64 + 1.476 UP KM/SEC.   SIGMA US = 0.94 PERCENT

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
J. APPL. PHYS., VOL. 31, P. 1253 (1960)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS BRASS
3) FOR THE BRASS STANDARD DATA SEE MATERIAL 36-33
4) V01 WAS TAKEN FROM THE AM. INST. OF PHYS. HANDBOOK (MCGRAW-HILL BOOK
CO., N.Y., 1963) 2ND ED.

TABLE I



26---3
TIN

SN

V0 = 0.1374 CC/G. CO = 2.674 KM/SEC
V01 = 0.1372 CC/G.

IN THE TABLES BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC. ST DESIGNATES THE STANDARD MATERIAL USED AS SAMPLE HOLDER IN TABLE I AND AS STRIKER OR PROJECTILE PLATE IN TABLE II. HERE U(ST) IS TOTAL VELOCITY BEFORE IMPACT.

TABLE I

SAMPLE					HOLDER		
RHOO	US	UP	P	V/VO	ST	US(ST)	UP(ST)
7.28	4.20	1.08	330	0.7407	FE	5.30	0.95
-	6.36	2.46	1139	0.6131	FE	7.53	2.24
-	9.02	4.65	3053	0.4845	FE	10.67*	4.26*

US =

TABLE II

SAMPLE					STRIKER	
RHOO	US	UP	P	V/VO	ST	U(ST)
7.28	5.99	2.15	938	0.6410	AL	5.60
-	7.22	3.06	1608	0.5764	FE	5.60
-	9.50	4.97	3437	0.4769	FE	9.10
-	12.98	7.96	7520	0.3868	FE	14.68

US = 2.730 + 1.524*UP - 0.030*UP**2. SIG.US = 0.14 KM/SEC.
OR US = 3.203 + 1.248*UP SIG.US = 0.21 KM/SEC.

COMMENTS:

1) SOURCE: AL'TSHULER, L.V., BAKANOVA, A.A. AND TRUNIN, R.F.
SOVIET PHYS.-JETP, VOL. 15, P. 65 (1962).
J. EXPTL. THEORET. PHYS. (USSR) VOL. 42, P. 91, (1962)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE B
3) TABLE I IS CORRECTED DATA WHICH FIRST APPEARED IN THE SOVIET PHYS.-JETP, VOL. 34, P. 614 (1958). THE * VALUES WERE OBTAINED FROM THE IRON STRIKER VELOCITY OF 8.64 KM/SEC.
4) THE INACCURACY IN THE DETERMINATION OF US IN TABLE II TO PRESSURES OF 4187 KILOBARS DID NOT EXCEED 1.0 PERCENT. EACH POINT IS THE AVERAGE

OF 4 TO 6 EXPERIMENTS:

5) THE UNCERTAINTY OF THE MEASURED VALUES IN THE LAST TABLE ENTRY ARE:
I PERCENT IN US, OBTAINED FROM 6-8 EXPERIMENTS AND 1.5 PERCENT IN
U(ST) OBTAINED FROM 12 EXPERIMENTS.

6) VOI WAS CALCULATED FROM THE TETRAGONAL UNIT CELL CONSTANTS
A = 5.81970 KX AND C = 3.17488 KX
AMERICAN INSTITUTE OF PHYSICS HANDBOOK (MCGRAW-HILL BOOK CO., N.Y.,
1963) 2ND ED.

7) CO IS GIVEN BY: K. H. SCHRAMM, Z. METALKUNDE VOL. 53, P. 729 (1962)

TABLE !

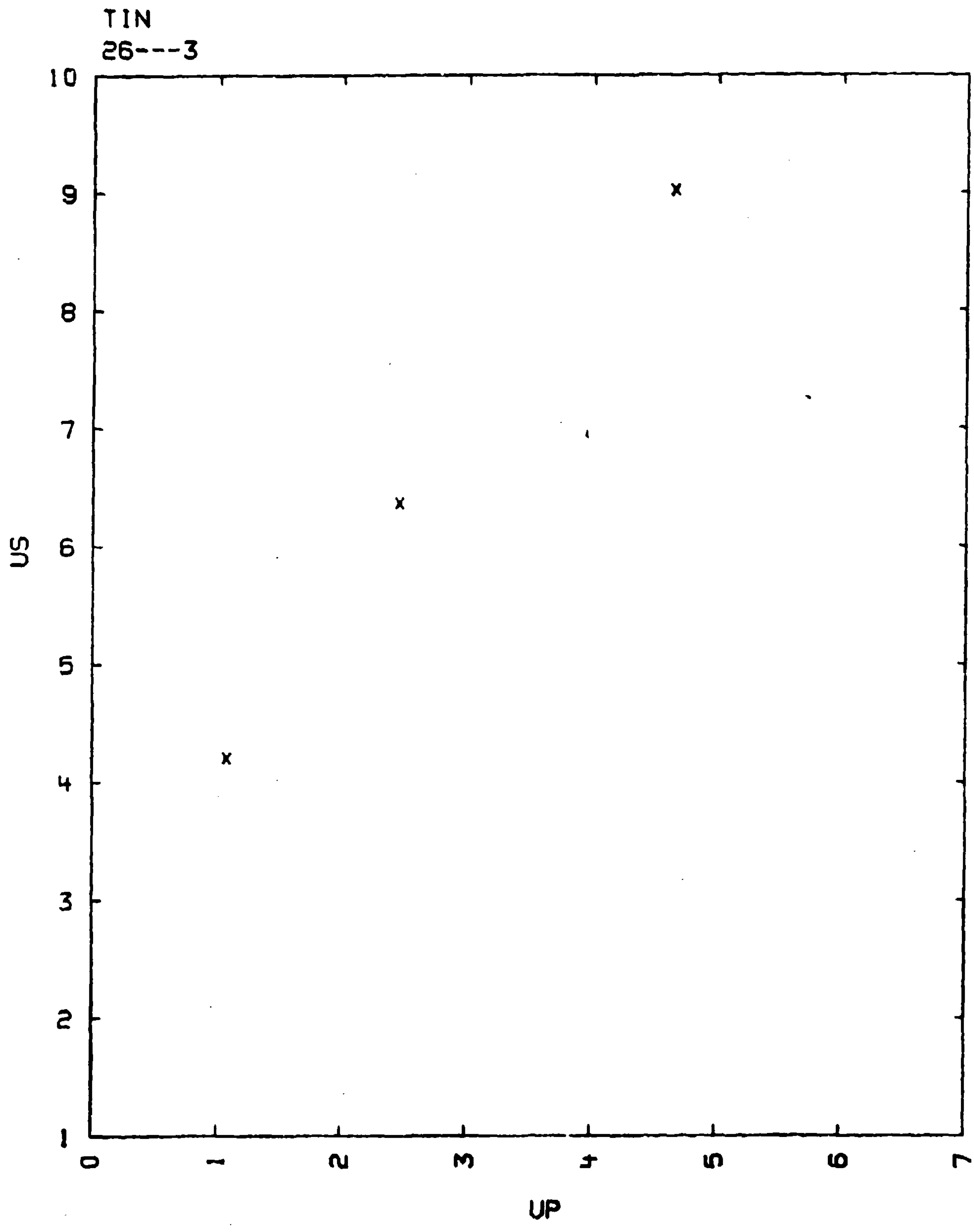
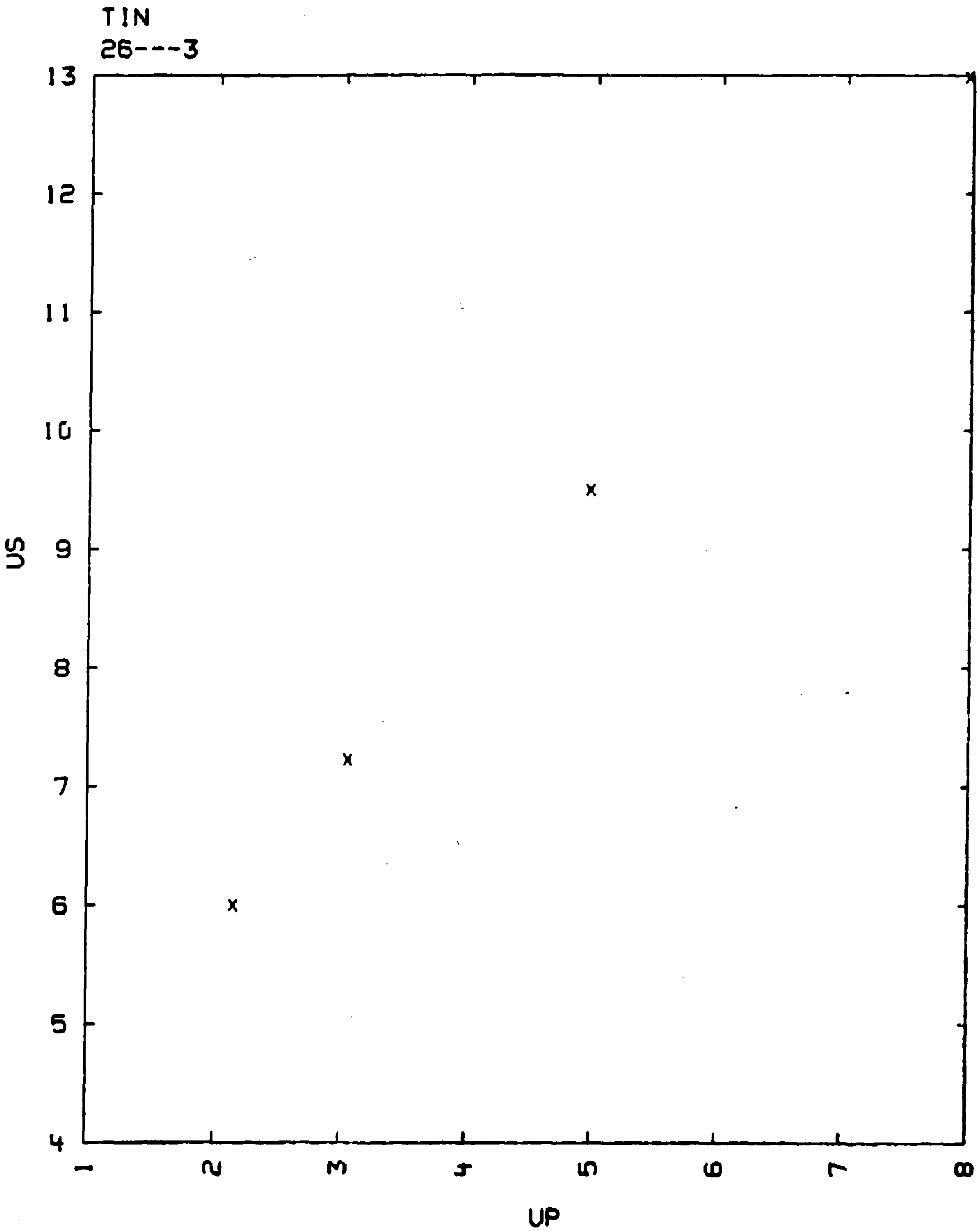


TABLE II



26---4
TIN

SN

V0 = 0.1368-0.1390 CC/G
V01 = 0.1372 CC/G

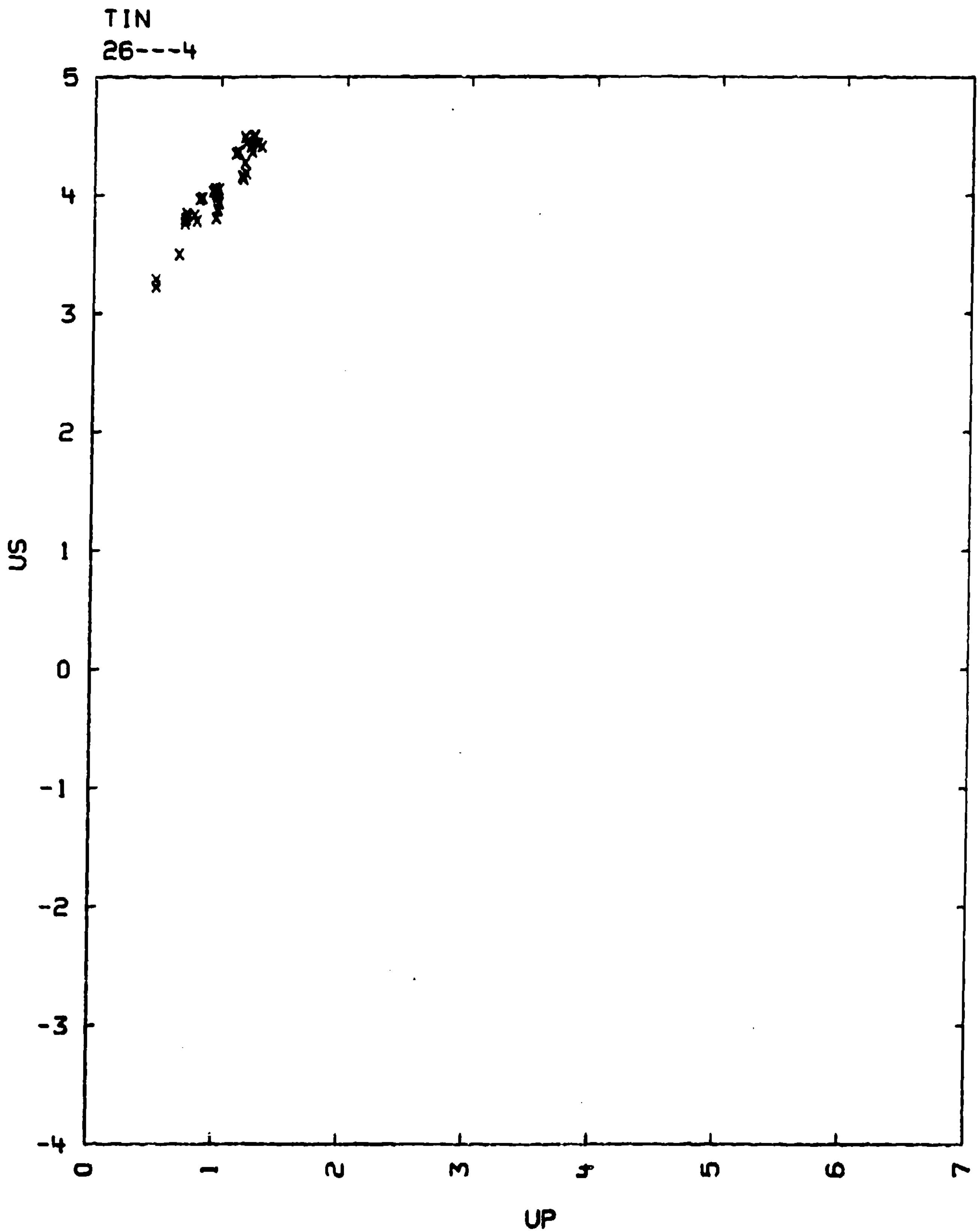
IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

SAMPLE					STANDARD
RHO0	US	UP	P	V/V0	UFS
7.30	4.401	1.330	427	0.698	3.290
7.30	4.425	1.291	417	0.708	3.220
7.31	4.484	1.271	417	0.716	3.200
7.31	4.500	1.270	418	0.718	3.200
7.31	4.405	1.236	398	0.719	3.095
7.31	4.359	1.251	399	0.713	3.110
7.31	4.433	1.213	393	0.726	3.050
7.31	4.488	1.195	392	0.734	3.025
7.27	4.266	1.200	372	0.719	2.960
7.27	4.181	1.204	366	0.712	2.940
7.31	4.344	1.126	358	0.741	2.830
7.31	4.359	1.144	365	0.738	2.880
7.30	4.149	1.175	356	0.716	2.875
7.30	4.132	1.182	357	0.713	2.890
7.31	3.980	0.983	286	0.753	2.415
7.31	4.042	0.990	292	0.755	2.440
7.31	4.055	0.966	286	0.762	2.400
7.31	4.032	0.953	281	0.764	2.360
7.31	4.023	0.973	285	0.757	2.400
7.31	4.010	0.973	286	0.758	2.400
7.31	3.931	0.989	284	0.745	2.400
7.31	3.873	0.983	278	0.750	2.400
7.31	3.884	0.975	277	0.749	2.365
7.31	3.798	0.971	269	0.744	2.335
7.31	3.965	0.848	246	0.786	2.115
7.31	3.971	0.862	250	0.782	2.145
7.31	3.824	0.804	225	0.790	1.985
7.31	3.779	0.819	226	0.783	2.000
7.31	3.791	0.736	204	0.806	1.830
7.31	3.837	0.739	207	0.807	1.840
7.31	3.759	0.720	198	0.808	1.780
7.31	3.791	0.722	200	0.810	1.795
7.31	3.492	0.686	175	0.804	1.640
7.31	3.484	0.686	175	0.803	1.640
7.31	3.274	0.497	119	0.848	1.195
7.31	3.222	0.499	117.5	0.845	1.190

US = 2.66 + 1.38*UP KM/SEC.
SIG US = 0.11

TABLE I



COMMENTS:

1) SOURCE: BERGER J. AND FAUQUIGNON C.
PRIVATE COMMUNICATION (1964), B.P. NO. 7, SEVRAN, FRANCE

2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL ALUMINUM AU4G ALLOY

3) VOI WAS DETERMINED FROM THE TETRAGONAL UNIT CELL CONSTANTS
A = 5.81970 KX AND C = 3.17488 KX
CRYSTAL DATA DETERMINATIVE TABLES (AMERICAN CRYSTALLOGRAPHIC ASSOCIATION, 1963) 2ND ED.

27---0
LEAD, SUMMARY

PB

VO = 0.0882 CC/G CL = 2.16 KM/SEC CO = 2.00 KM/SEC
VOI= 0.08818 CC/G CS = 0.70 KM/SEC CB= 2.00 KM/SEC

THE TABLE LISTS HUGONIOT POINTS OBTAINED FROM THE LISTED US VS. UP FITS. DENSITY IS IN G/CC, VELOCITIES IN KM/SEC, PRESSURE IN KBAR AND ENERGY DIFFERENCE IN KBAR.CC/G. THE FIRST 8 ENTRIES ARE FROM 27---8. EL = ELASTIC LIMIT.

TABLE

FIT	RHOO	US	UP	P	V/VO	E-EO	COMMENTS	
	11.34	2.3	.00093	0.24	0.9996	0.0004	1ST WAVE	EL
	-	1.90	.0193	4.20	0.9901	0.0021	2ND	-
	-	1.95	.0282	6.28	0.9853	0.0041	-	-
	-	2.08	.0500	11.82	0.9736	0.0124	-	-
	-	2.15	.1146	27.95	0.9466	0.0657	-	-
	-	2.26	.1834	47.24	0.9191	0.1682	1ST	-
	-	2.37	.2546	68.55	0.8926	0.324	-	-
	-	2.44	.2822	78.12	0.8842	0.398	-	-
1	-	2.467	.3	83.9	0.8784	45	-	-
1	-	2.929	.6	199.3	0.7951	1.80	-	-
1	-	3.544	1.0	402	0.7178	5.0	-	-
1	-	4.313	1.5	733	0.6522	11.2	-	-
1	-	5.082	2.0	1152	0.6064	20.0	-	-
2	-	5.364	2.2	1338	0.5898	24.2	-	-
2	-	6.363	3.0	2165	0.5285	45.0	-	-
2	-	7.613	4.0	3453	0.4746	80.0	-	-
2	-	8.862	5.0	5024	0.4358	125.0	-	-
2	-	10.11	6.0	6879	0.4066	180.0	-	-
2	-	11.36	7.0	9017	0.3838	245.0	-	-

US = 2.006 + 1.538*UP KM/SEC (FIT 1)
SIG US = 0.014 KM/SEC
US = 2.616 + 1.249*UP KM/SEC (FIT 2)
SIG US = 0.065 KM/SEC

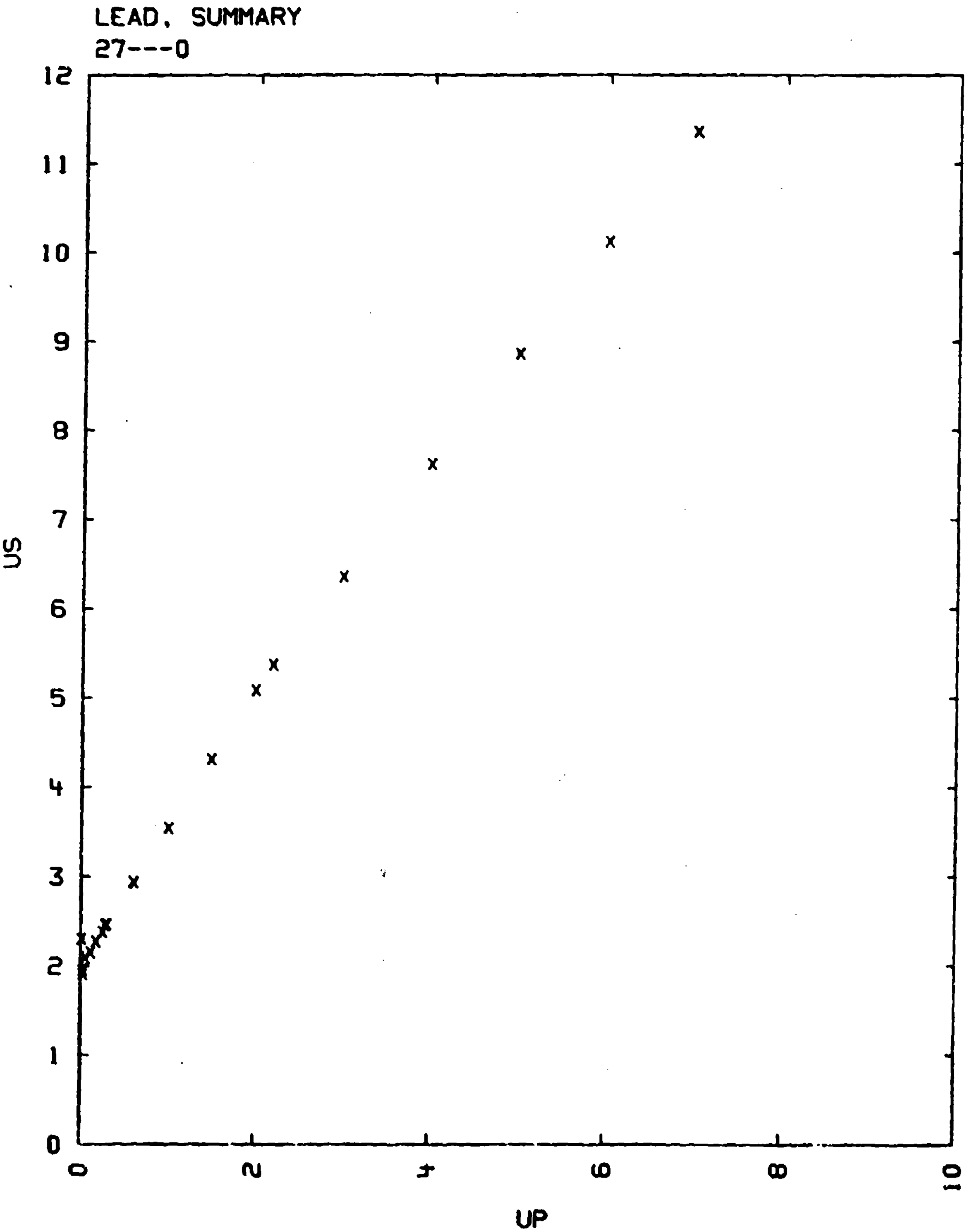
COMMENTS

1) SOURCE: COMPILER
1A) THE FITS WERE MADE FROM THE DATA OF 27---1,2,4 AND 7. THE LOW PRESSURE DATA LISTED IN 27---8, WERE TRANSFERRED DIRECTLY WITHOUT INCLUDING THE RECALCULATED US AND UP POINTS IN THE FIT.
2) FIT 1 AGREES ESSENTIALLY WITH THE DATA OF PAGE 27---8 ABOVE 10 KBAR BUT THE LOWEST POINTS SUGGEST A LOWER INTERCEPT. THEIR UP VALUES

HAVE BEEN SLIGHTLY READJUSTED TO YIELD THE PROPER VALUE OF P IN A SIMPLE TWO-STEP PROCESS(SEE COMMENTS OF 27---8).

3) DATA OF 27---3 ARE IN GREATER DISAGREEMENT, WHILE US UP VALUES OF 27---6 ARE CALCULATED POINTS.

TABLE I



27---1
LEAD

PB 99.8 PER CENT OR GREATER

V0 = 0.0882 CC/G CL = 2.16 KM/SEC. C0 = 2.00 KM/SEC.
V01 = 0.0881 CC/G CS = 0.70 KM/SEC .

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC.
PRESSURE IN KILOBARS, AND DENSITY IN G/CC.

TABLE

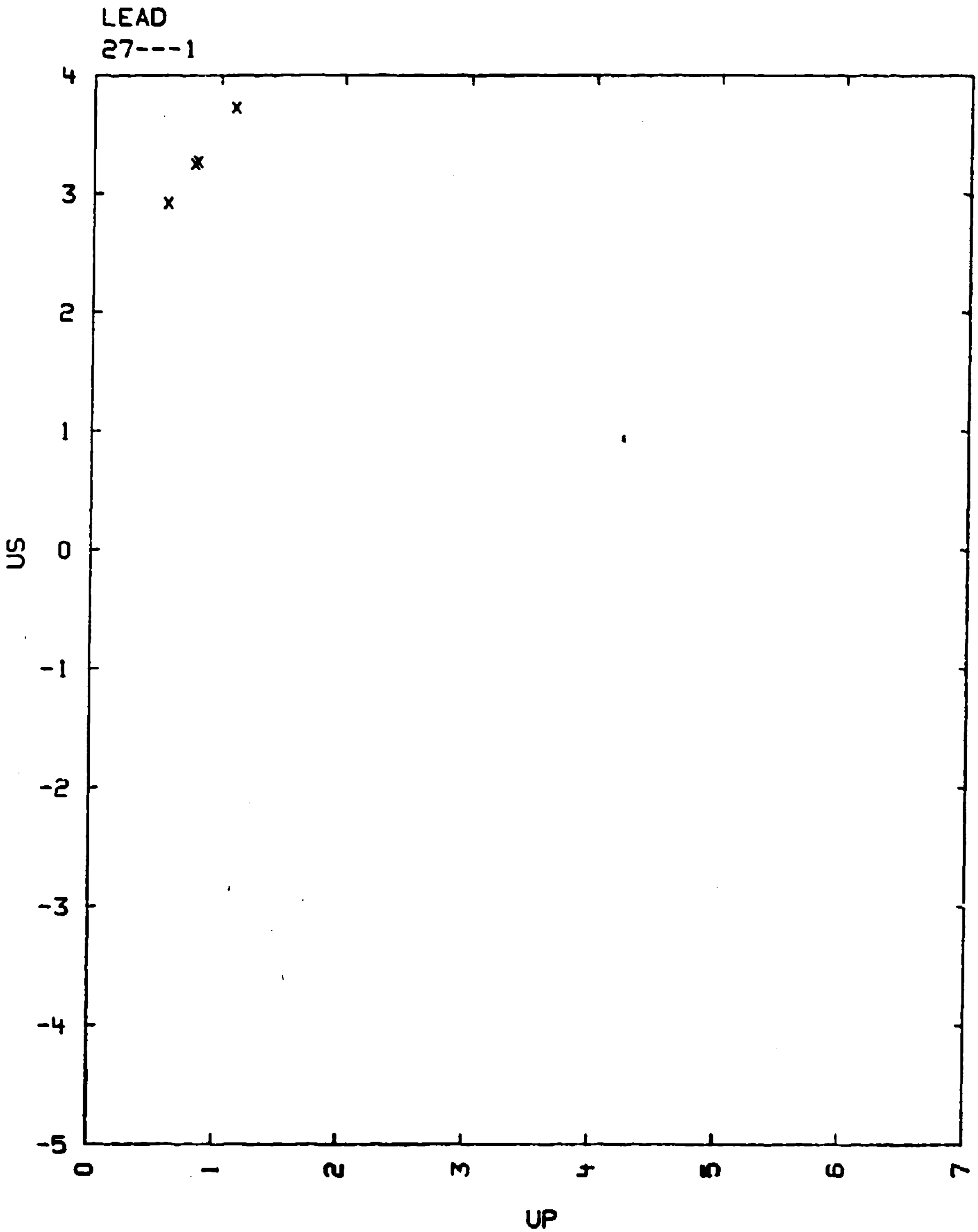
RHO0	US	UFS	UP	P	V/V0
11.34	2.914	1.230	0.590	194.8	0.7975
-	3.268	1.745	0.819	303.2	0.7494
-	3.250	1.731	0.802	295.3	0.7532
-	3.724	2.420	1.118	471.7	0.6998

US = 2.092 + 1.452 UP KM/SEC SIGMA US = 0.4 PERCENT

COMMENTS:

1) SOURCE: WALSH, J. M., RICE, M. H., MCQUEEN, R. G. AND YARGER, F. L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION TECHNIQUE B.
STANDARD MATERIAL 24ST ALUMINUM.
3) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS.
4) CL AND CS VALUES WERE OBTAINED FROM L. BERGMANN, DER ULTRASCHALL,
S. HIRZEL VERLAG, STUTTGART, 1954, 6TH ED., P. 650
5) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY
FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 1 PER CENT IN
COMPRESSION AT A GIVEN PRESSURE.

TABLE I



27---2
LEAD

PB

V0 = 0.0882 CC/G   CB = 2.02 KM/SEC
V01 = 0.0881 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURES IN KILOBARS AND DENSITY IN G/CC.

TABLE

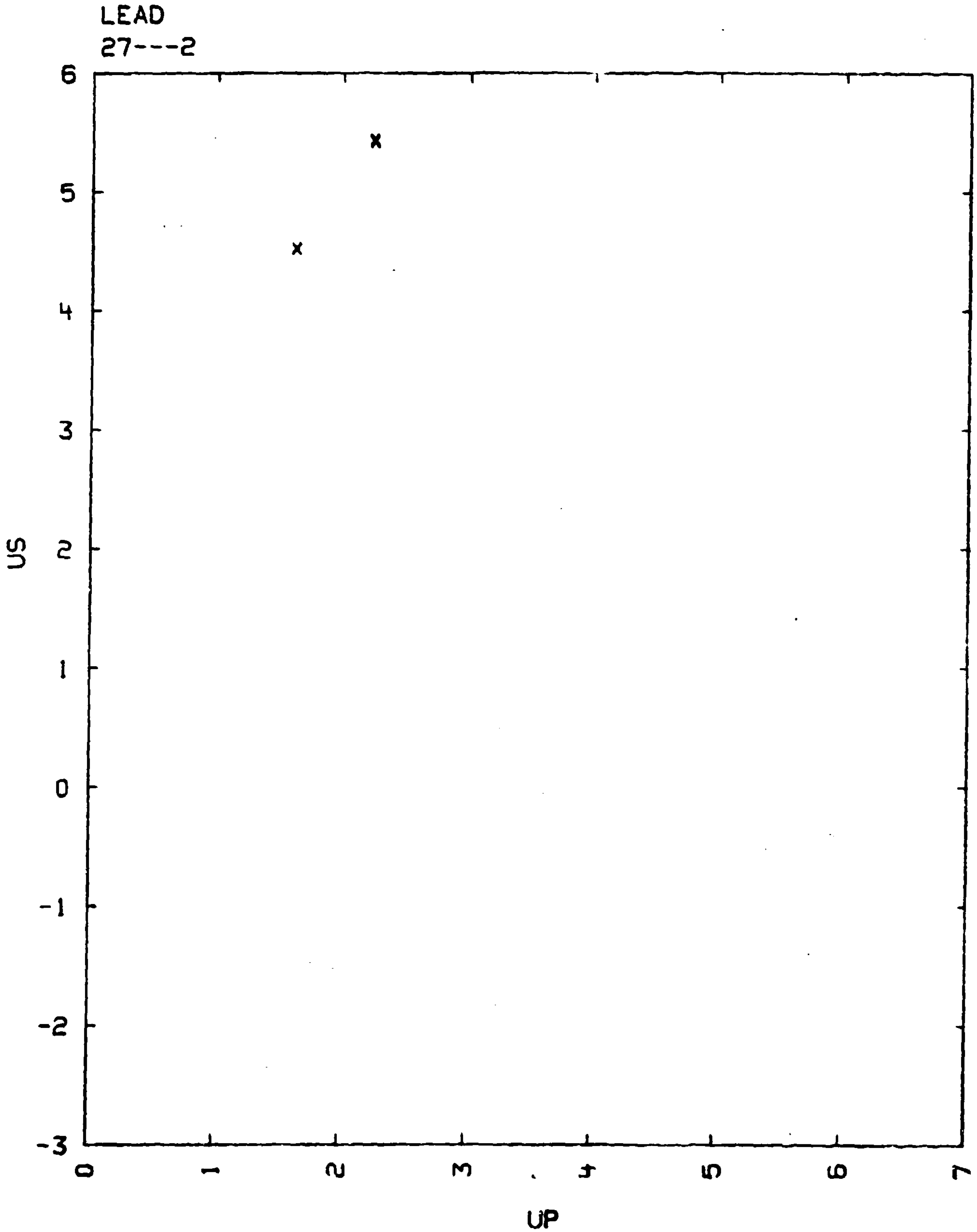
RHO0	US	UP	P	V/V0	PRESSURE IN BRASS STANDARD
11.34	4.52	1.64	838	0.638	842
	4.52	1.64	837	0.638	842
-	5.44	2.25	1388	0.587	1354
-	5.42	2.25	1383	0.585	1352

US = 2.028 + 1.517 UP KM/SEC.   SIGMA US = 0.11 PERCENT

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
J. APPL. PHYS., VOL. 31, P. 1253 (1960)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS BRASS
3) FOR THE BRASS STANDARD DATA SEE MATERIAL 36-33
4) V01 WAS TAKEN FROM THE A. I. P. HANDBOOK (MCGRAW HILL BOOK CO.) 2ND ED.

TABLE I



27---3
LEAD

PB

V0 = 0.0882 CC/G.
V01 = 0.0882 CC/G. CB = 2.00 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

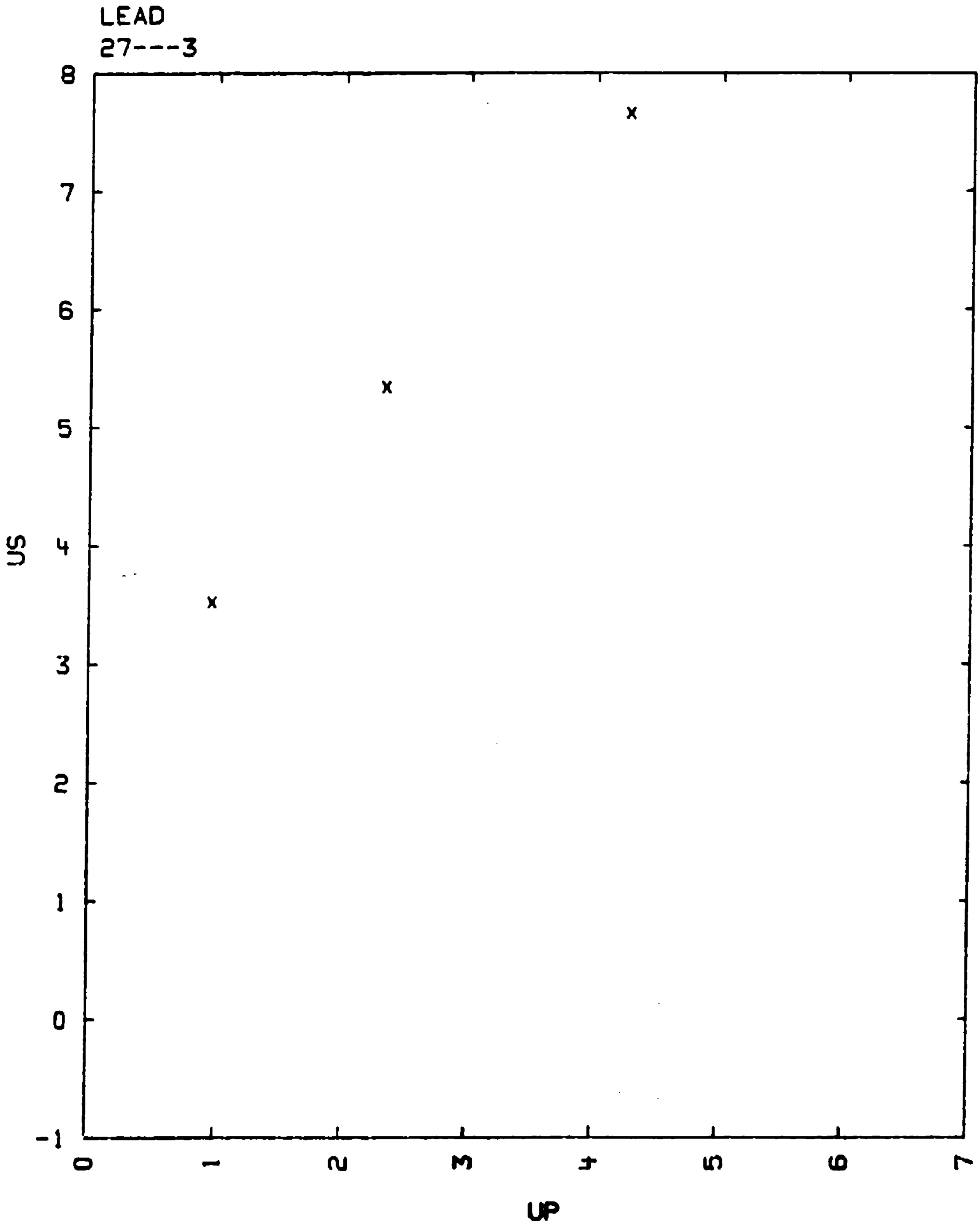
RHOO	US	UP	P	V/VO
11.34	3.52	0.97	390	0.725
-	5.33	2.34	1410	0.562
-	7.65	4.26	3700	0.442

US = 2.30 + 1.27UP KM/SEC.

COMMENTS:

1) SOURCE: AL'TSHULER, L. V., KRUPNIKOV, K. K. AND BRAZHNIK, M. I.
SOVIET PHYS.-JETP, VOL. 7, P. 614, (1958)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL FE.
3) CB IS CALCULATED USING THE VOLUME COMPRESSION COEFFICIENT TAKEN FROM P. W. BRIDGMAN, THE PHYSICS OF HIGH PRESSURE, (G. BELL AND SONS LTD. LONDON 1958)
4) V01 WAS OBTAINED FROM THE AMERICAN INSTITUTE OF PHYSICS HANDBOOK (MCGRAW-HILL BOOK CO. 1963) 2ND ED.
5) THE SPECIMEN WITH A THICKNESS BETWEEN 6-8MM. WAS ATTACHED TO AN IRON PLATE OF COMPARABLE THICKNESS 6-9MM.

TABLE I



27---4
LEAD

PB

VO = 0.0882 CC/G.
VOI = 0.0881 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC. ST DESIGNATES THE STANDARD MATERIAL USED AS STRIKER PLATE. U(ST) IS THE STRIKER VELOCITY BEFORE IMPACT.

TABLE

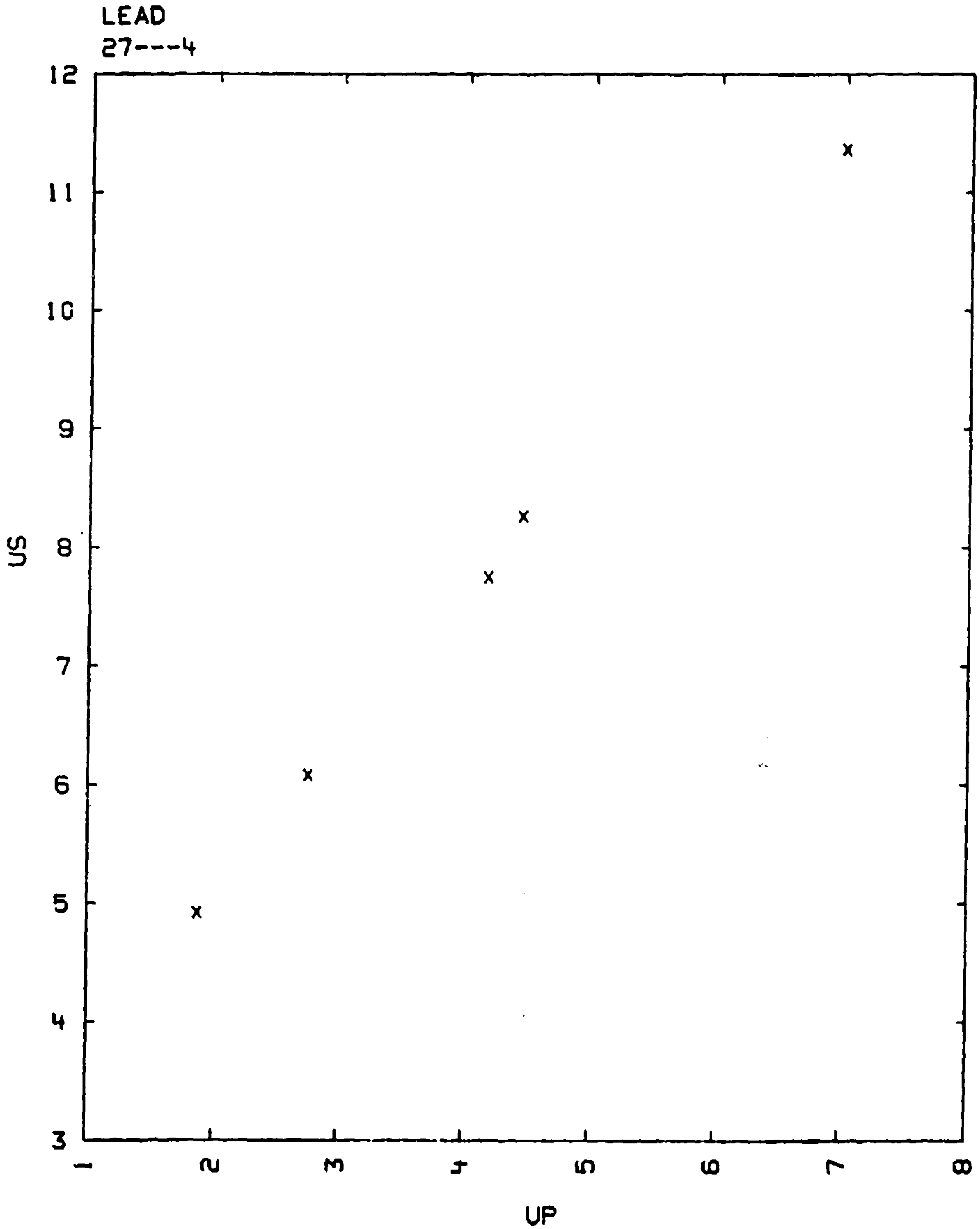
RHOO	US	UP	P	V/VO	ST	U(ST)
11.34	4.92	1.88	1049	0.6180	AL	5.60
-	6.07	2.76	1900	0.5453	FE	5.60
-	7.74	4.18	3669	0.4600	FE	8.64
-	8.26	4.45	4170	0.4613	FE	9.10
-	11.36	7.00	9150	0.3750	FE	14.68

US = 2.58 + 1.26 UP   FOR UP BETWEEN 1.88 TO 7.00 KM/SEC.
SIGMA US = 0.08 KM/SEC.

COMMENTS:

1) SOURCE: AL'TSHULER, L.V., KORMER, S.B., BAKANOVA, A.A. AND TRUNIN, R.F.
SOVIET PHYS-JETP, VOL. 11, PAGE 573 (1960)
AL'TSHULER, L. V. ET AL
SOVIET PHYS.-JETP, VOL. 15, P. 65 (1962)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE A
3) THE PRESSURES WERE PRODUCED BY AN EXPLOSIVELY ACCELERATED ALUMINUM OR STEEL PLATE AS INDICATED IN COLUMN 6.
4) THE INACCURACY IN THE DETERMINATION OF US AND UP FOR PRESSURES TO 4187 KILOBARS DID NOT EXCEED 1.0 PERCENT. EACH POINT IS THE AVERAGE OF 4 TO 6 EXPERIMENTS.
5) THE U UNCERTAINTY OF THE VALUES IN THE LAST TABLE ENTRY ARE: 1 PERCENT IN US OBTAINED FROM 6-8 EXPERIMENTS AND 1.5 PERCENT IN U(ST) OBTAINED FROM 12 EXPERIMENTS.
6) VOI WAS OBTAINED FROM THE AMERICAN INSTITUTE OF PHYSICS HANDBOOK (MCGRAW-HILL BOOK CO. 1963) 2ND ED.
THE CORRESPONDING LATTICE PARAMETERS FOR THE FACE CENTERED CUBIC CELL IS 4.9496 ANGSTROMS.

TABLE I



27---5
LEAD POROUS

PB 99.5 PERCENT
AVERAGE GRAIN SIZE IS 8 MICRONS

V01 = 0.08818 CC/G.
VO = 1/RHOO SEE TABLE

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURES IN KILOBARS AND DENSITY IN G/CC. ST DESIGNATES THE STANDARD MATERIAL AND THE MATERIAL OF THE STRIKER PLATE. U(ST) IS THE STRIKER VELOCITY BEFORE IMPACT. ST LABELS THE HUGONIOT VARIABLES OF THE IRON SAMPLE HOLDER.

TABLE

- - - - - - - - SAMPLE - - - - -						- - - - DRIVER SYSTEM - - - -				
RHOO	US	UP	SIGMA US	P	V/VO	ST	U(ST)	US(ST)	UP(ST)	P(ST)
6.79	7.79	4.995	.04	2642	.5988	FE	8.64	10.67	4.26	3568
6.79	12.74	8.439	.16	7300	.5637	FE	15.45			

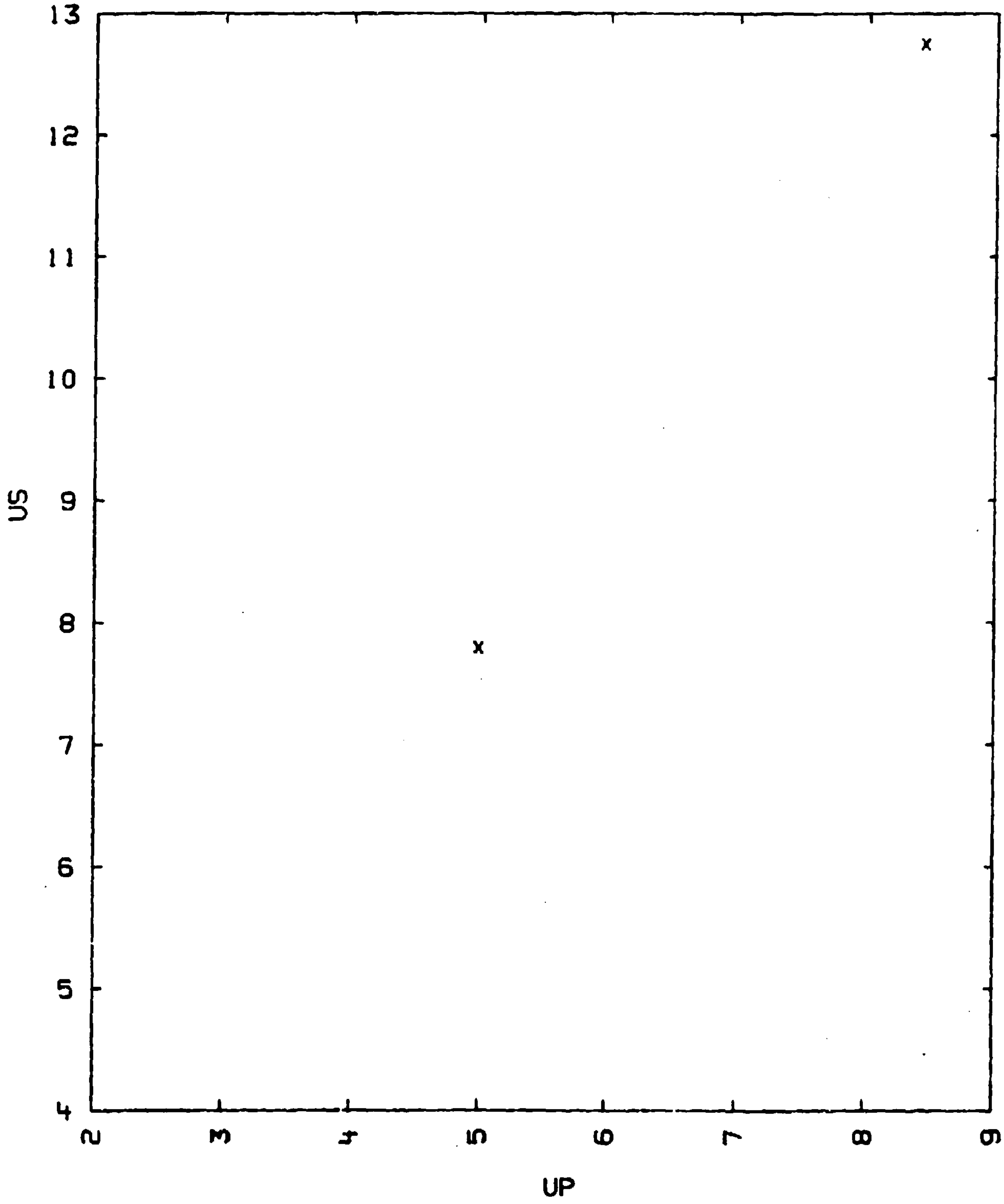
US =

COMMENTS:

1) SOURCE: KORMER, S.B., FUNTIKOV, A.L., URLIN, V.D.
AND KOLESNIKOVA, A.N.
SOVIET PHYS.-JETP, VOL. 15, P. 477 (1962)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE B
3) US IS THE AVERAGE DETERMINATION TAKEN FROM 4-8 EXPERIMENTS, EACH CONSISTING OF 4-6 READINGS.
4) V01 WAS OBTAINED FROM THE HANDBOOK OF CHEMISTRY AND PHYSICS (THE CHEMICAL RUBBER PUBLISHING CO., CLEVELAND, OHIO, 1962-1963) 44TH ED.

TABLE I

LEAD POROUS
27---5



27---6
LEAD

PB

V0 = 0.08826 G/CC.
V0I = 0.08818 G/CC.

THE TABLE BELOW GIVE THE VELOCITIES OF RELAXATION WAVES, C, AT VARIOUS PRESSURES. THE HUGONIOT STATE THE RELAXATION WAVE TRAVELS THROUGH IS GIVEN BY US, UP, P, OR V/V0. DENSITY IS GIVEN IN G/CC., VELOCITY IN KM/SEC. AND PRESSURE IN KILOBARS. ST DESIGNATES THE MATERIAL OF THE STRIKER PLATE, U(ST) IS THE VELOCITY BEFORE IMPACT AND US(ST) IS THE SHOCK VELOCITY IN THE PLATE AFTER IMPACT.

TABLE

SOUND VELOCITY
PARALLEL TO SHOCK DIRECTION

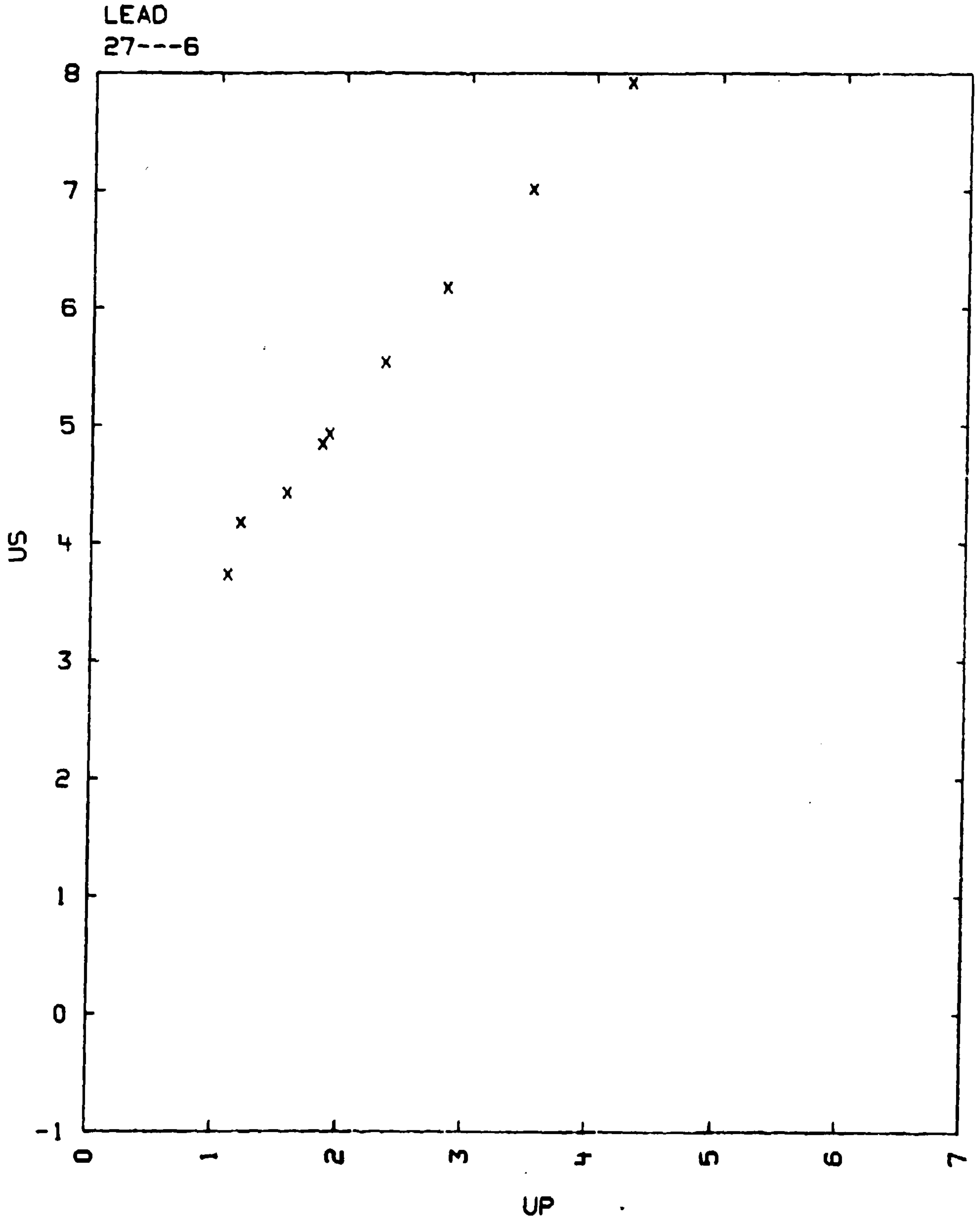
	---HUGONIOT STATE--------					--DRIVER SYSTEM--		
RHO0	US	UP	P	V/V0	C	ST	U(ST)	US(ST)
11.34	4.91	1.89	1052	0.6150		AL	5.60	10.34
-	4.16	1.20	656	0.6658	4.24	AL	5.60	10.34
-	3.72	1.10	464	0.7042	3.85	AL	5.60	10.34
-	6.17	2.82	1973	0.5429		FE	5.71	8.61
-	5.53	2.34	1467	0.5767	5.16	FE	5.71	8.61
-	4.83	1.84	1008	0.6188	4.62	FE	5.71	8.61
-	4.41	1.56	780	0.6472	4.29	FE	5.71	8.61
-	7.92	4.28	3850	0.4593	6.56	FE		
-	7.01	3.51	2795	0.4993	5.92	FE		

US =

COMMENTS:

1) SOURCE: AL'TSHULER, L. V., KORMER, S. B., BRAZHNIK, M. I., VLADIMIROV, L. A. AND FUNTIKOV, A. I. SOVIET PHYS.-JETP, VOL.11, P. 766 (1960)
2) EXPERIMENTAL TECHNIQUE A WAS USED FOR THE FIRST THREE ENTRIES. FOR ALL OTHER ENTRIES THE EXPERIMENTAL TECHNIQUE B WAS USED. THE HUGONIOT STATE WAS DETERMINED FROM ONE MEASURED PARAMETER AND THE KNOWN EQUATION OF STATE. AL'TSHULER ET AL. SOVIET PHYS-JETP, VOL. 11, P. 573 (1960).
3) THE SOUND VELOCITY WAS DETERMINED FROM THE ATTENUATION IN THE MEASURED SHOCK OR FREE SURFACE VELOCITY PRODUCED BY THE RAREFACTION WAVE ORIGINATING AT THE REAR SURFACE OF THE STRIKER PLATE.
4) V0I WAS OBTAINED FROM THE HANDBOOK OF CHEMISTRY AND PHYSICS (THE CHEMICAL RUBBER PUBLISHING CO., CLEVELAND, OHIO, 1962-1963) 44TH ED.

TABLE I



27---7
LEAD

PB

VO = 0.08811 CC/G
VOI = 0.088176 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN KM/SEC, AND PRESSURE IN KILOBARS.

TABLE

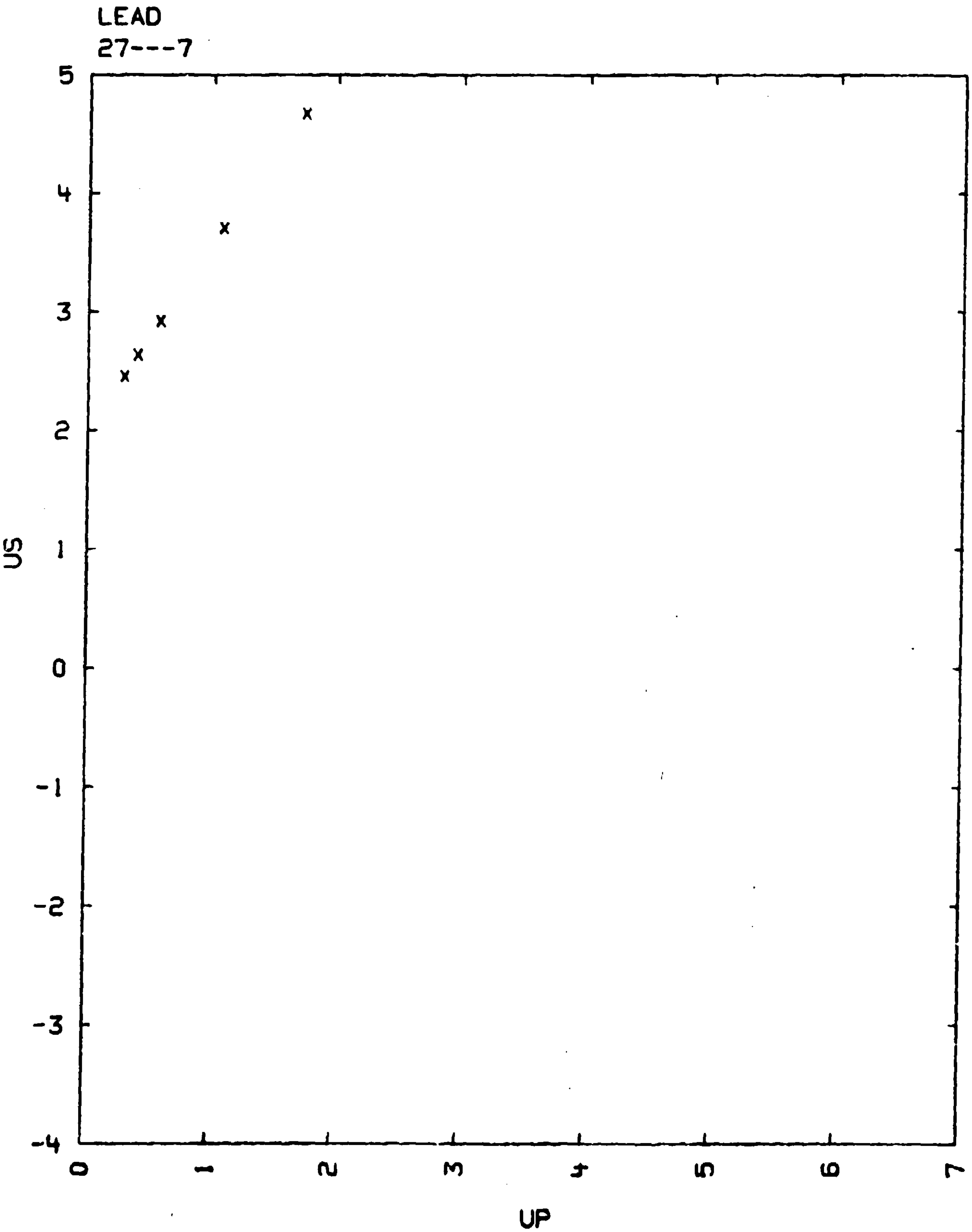
SAMPLE						BASE PLATE	
RHOO	US	UFS	UP	P	V/VO	MATERIAL	PRESSURE
11.35	4.66	3.77	1.74	920	0.526	AL	618
11.35	2.91	1.22	0.59	195	0.797	AL	146
11.35	3.70	2.30	1.09	457	0.705	AL	324
11.35	2.63	0.82	0.40	120	0.848	BRASS	133
11.34	2.45	0.61	0.30	83	0.879	BRASS	95

US = 2.01 + 1.53 UP KM/SEC
SIGMA US = 0.019 KM/SEC

COMMENTS:

1) SOURCE: COMPILER
L.R.L. EQUATION OF STATE FILE
LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIFORNIA.
2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION TECHNIQUE B.
3) THE VALUE OF VOI WAS OBTAINED FROM A. TAYLOR AND BRENDA J. KAGLE, CRYSTALLOGRAPHIC DATA ON METAL AND ALLOY STRUCTURES (DOVER PUBLICATIONS, INC., NEW YORK, N. Y., 1963).

TABLE I



27---8
LEAD

CU, FE, ZN, BI, AG AND OTHERS LESS THAN 0.082 WT PERCENT
PB REMAINDER - -

V0 = 0.08807 G/CC CO = 1.972 KM/SEC.
V01= 0.08816 G/CC

THE TABLE LISTS ALL THE PRESSURES AND COMPRESSIONS OF THE MULTIPLE WAVE SYSTEMS USED IN THE DATA ANALYSIS OF THESE RELATIVELY BROAD SHOCK WAVES, TOGETHER WITH THE HYDROSTATIC PRESSURE (PH) AND THE APPROXIMATE USI AND UPI VALUES CALCULATED FROM THEM. DENSITY IS IN G/CC, VELOCITIES IN KM/SEC AND PRESSURE OR STRESS IN KBARS. NO = EXPERIMENT NUMBER. I INDICATES THE 1ST, 2ND, 3RD ETC. WAVE OF THE SYSTEM. U = PROJECTILE VELOCITY AND MAT IS THE PROJECTILE MATERIAL.

TABLE

U	RHO0	US	UP	P	V/V0	I	PH	MAT
.0401	11.355	2.3	0.00093	.25	0.9996	1		PB
		1.94	0.0092	2.08	0.9953	2		
		1.85	0.0179	3.90	0.9906	3		
		2.	0.0191	4.20	0.9901	4	4.15	
.0599	-	2.3	0.00091	0.24	0.9996	1		-
		1.96	0.0089	2.01	0.9955	2		
		1.95	0.0190	4.23	0.9903	3		
		1.91	0.0285	6.28	0.9853	4	6.22	
.1264	-	2.08	0.0438	10.13	0.9785	1		
		1.76	0.0523	11.82	0.9736	2	11.75	-
.3025	-	2.15	0.1146	27.95	0.9466	1	27.86	AL 6061-T6
.5020	-	2.26	0.1834	47.24	0.9191	1	47.13	- -
.4270	-	2.37	0.2546	68.55	0.8926	1	68.42	NI
.4940	-	2.44	0.2822	78.12	0.8842	1	77.99	-

US = SEE COMMENT 3

COMMENTS

1) SOURCE: MUNSON, D. E. AND BARKER, L. M.
J. APPL. PHYS., VOL. 37, P. 1652, (1966)
SANDIA CORPORATION, ALBUQUERQUE, NEW MEXICO.
2) EXPERIMENTAL TECHNIQUE F
DATA REDUCTION METHOD D WITH 2UP = UFS

WITH THE MODIFICATION THAT A SMOOTH BROAD WAVE IS APPROXIMATED BY A SET OF DISCREET PRESSURE STEPS. THE SHOCK VELOCITY MEASUREMENTS WERE CORRECTED FOR ERRORS INTRODUCED BY SURFACE INTERACTIONS.

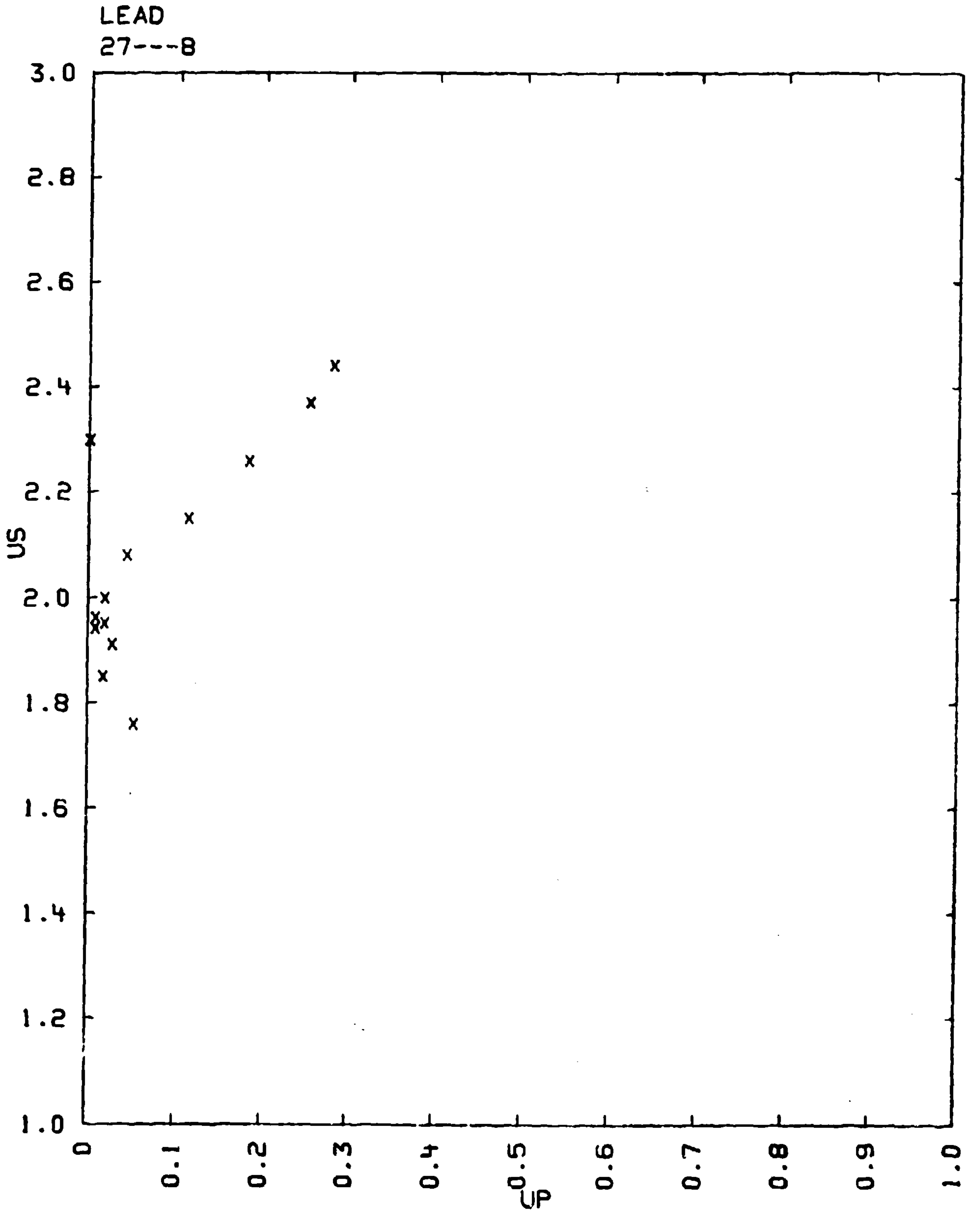
3) NOTE THAT USI AND UPI ARE ONLY APPROXIMATE NUMBERS CALCULATED FROM THE PI AND VI/VO VALUES TO ILLUSTRATE THE WAVE THICKNESS. IN THE FIT BELOW US IS OBTAINED FROM THE MAXIMUM VALUE OF PH OF THE PARTICULAR WAVE SYSTEM AND THE CORRESPONDING VALUE OF VI, USING THE EQUALITY US = VO(PH/(VO-VI))**1/2, WHILE UP WAS TAKEN TO BE 1/2 THE MAXIMUM FREE SURFACE VELOCITY. THESE POINTS ARE COMBINED WITH DATA FROM LOS-ALAMOS SCIENTIFIC LABORATORY TO GIVE:

US = 1.952 + 1.562*UP KM/SEC, UP FROM 0 TO 2.3 KM/SEC.
MAX. DEVIATION 3.4 PERCENT

4) PH = PI - 2/3*Y, WHERE THE YIELD POINT Y IS A FUNCTION OF THE DEGREE OF WORK HARDENING.

5) VOI WAS CALCULATED FROM THE CUBIC UNIT CELL CONSTANT GIVEN IN WYCKOFF, CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, 1963) A = 4.9505 ANGSTROM.

TABLE I



LEAD
27---8
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
US
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP

29---1
ALUMINUM

AL

VO = 0.370 CC/G CL = 6.260 KM/SEC
VOI = 0.370 CC/G CS = 3.080 KM/SEC

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN MM/MICROSEC, AND PRESSURE IN KILOBARS.

TABLE

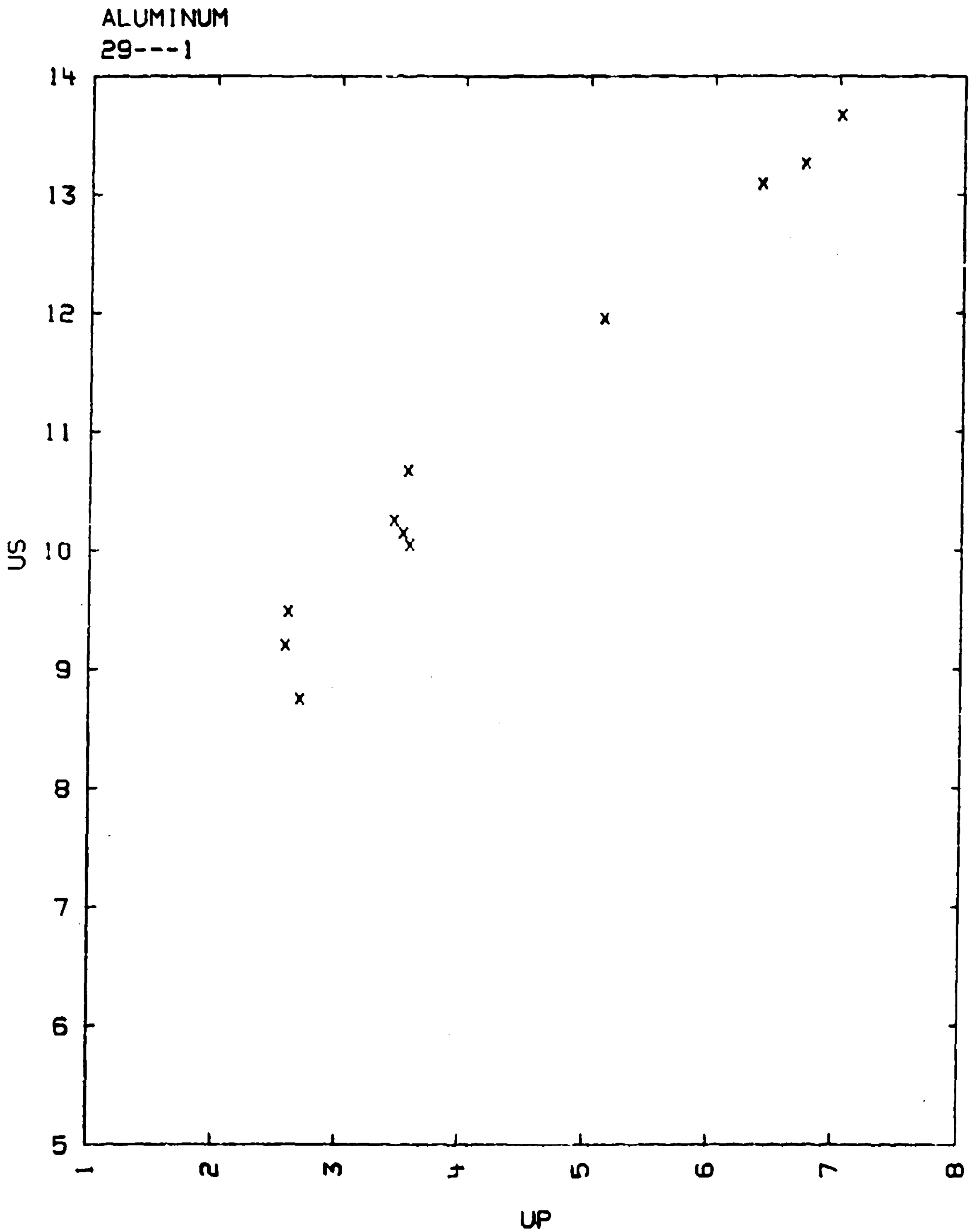
RHOO	US	UP	P	V/VO
2.70	8.74	2.70	640	.691
-	9.20	2.58	641	.719
-	9.48	2.60	665	.726
-	10.14	3.53	974	.652
-	10.04	3.58	977	.643
-	10.24	3.45	958	.606
-	10.67	3.56	1030	.665
-	11.95	5.13	1650	.571
-	13.09	6.38	2250	.513
-	13.26	6.73	2410	.493
-	13.67	7.02	2590	.487

US = 5.38 + 1.337UP MM/MICROSEC FOR UP LESS THAN 3.24
US = 5.38 + 1.337UP - 0.0830(UP - 3.24)**2 MM/MICROSEC
FOR UP GREATER THAN 3.24

COMMENTS:

1) SOURCE: SKIDMORE, I.C. AND MORRIS, E.
THERMODYNAMICS OF NUCLEAR MATERIALS, P. 173 FF. (1962)
INTERN. AT. ENERGY AGENCY, VIENNA
ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON, ENGLAND
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE A AND B
THE SAMPLES WERE POSITIONED ON A TARGET PLATE OF STEEL (MTRL. 41---2) AND THE PRESSURE WAS PRODUCED BY AN EXPLOSIVELY ACCELERATED PLATE OF STEEL.
3) THE VELOCITY OF THE FLYING PLATE AND THE SHOCK AND SURFACE VELOCITY OF THE TARGET PLATE WERE MEASURED AS WELL AS THE SAMPLE SURFACE AND SHOCK VELOCITIES.
4) DATA SCATTER WAS ABOUT 0.03 MICROSEC.
5) CORRECTIONS WERE MADE FOR FLYING PLATE CURVATURE OF UP TO 1 MICROSEC.
6) THE HIGHER PRESSURES WERE OBTAINED BY A SPHERICALLY CONVERGING SYSTEM.
7) CL AND CS FROM L. BERGMAN: DER ULTRASCHALL, S. HIRZEL VERLAG, STUTTGART, (1954).

TABLE I



29---2
ALUMINUM

AL 97.9 PERCENT
MG 1.0 PERCENT
SI 0.6 PERCENT
CU 0.25 PERCENT
CR 0.25 PERCENT

V0 = 0.3707 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC.,
PRESSURE IN KBARS AND DENSITY IN G/CC. D IS SAMPLE THICKNESS IN MM.
PROJ. DESIGNATES THE PROJECTILE MATERIAL: ALUMINUM(AL) OR 4340 STEEL(FE)

TABLE I

NO	RHO0	US1	UP1	UFS1	US2	UP2	UFS2	D
1	2.698	5.99	0.010	0.021				2.5
2	-	6.09	0.014	0.030				2.5
3	-	6.05	0.026	0.054				1.25
4	-	5.84	0.031	0.063				1.25
5	-	6.02	0.031	0.064				2.5
6	-	6.23	0.038	0.075				2.5
7	-	6.23			5.47	0.043	0.087	2.5
8	-	6.27			5.87	0.044	0.086	2.5
9	-	5.21			5.60	0.046	0.088	1.25
10	-	6.49			5.78	0.047	0.089	2.5
11	-	6.33			5.36	0.060	0.118	1.25
12	-	6.19			5.36	0.063	0.118	2.5
13	-	6.39			5.32	0.074	0.135	1.25
14	-	6.39			5.53	0.074	0.128	2.5
15	-	6.31			5.42	0.075	0.131	2.5
16	-	6.23			5.48	0.075	0.126	2.5
17	-	6.31			5.50	0.088	0.152	2.5
18	-	6.28			5.40	0.088	0.155	2.5
19	-	6.34			5.50	0.092	0.173	1.25
20	-	6.54			5.51	0.092	0.169	1.25
21	-	6.18			5.28	0.097	0.181	1.25
22	-	6.51			5.59	0.102	0.162	2.5
23	-	6.20			5.34	0.102	0.187	1.25
24	-	5.06			5.25	0.116	0.217	1.25
25	-	6.30			5.47	0.116	0.186	2.5
26	-	6.23			5.37	0.121	0.213	2.5
27	-	6.23			5.36	0.122	0.232	1.25
28	-	6.14			5.25	0.123	0.235	1.25
29	-	6.25			5.41	0.130	0.229	2.5
30	-	6.22			5.36	0.136	0.258	1.25
31	-	6.33			5.42	0.136	0.244	2.5
32	-	6.35			5.47	0.141	0.245	2.5
33	-	6.38			5.48	0.145	0.252	2.5
34	-	6.36			5.47	0.154	0.261	2.5
35	-	6.26			5.49	0.166	0.317	1.25

ALUMINUM

NO	RHOO	US1	UP1	UFS1	US2	UP2	UFS2	D
36	-	6.25			5.45	0.184	0.353	1.25
37	-	6.19			5.44	0.208	0.401	1.25

US =

TABLE II

NO	P1	V1/V0	P2	V2/V0	PROJ.
1	1.58	0.9985			AL
2	2.42	0.9977			-
3	4.42	0.9958			-
4	5.20	0.9950			-
5	5.32	0.9949			-
6	6.33	0.9940			-
7			7.12	0.9930	-
8			7.43	0.9928	-
9			7.59	0.9925	-
10			7.81	0.9923	-
11			9.58	0.9898	-
12			10.01	0.9892	-
13			11.50	0.9872	-
14			11.78	0.9873	-
15			11.80	0.9870	-
16			11.88	0.9871	-
17			13.79	0.9848	-
18			13.76	0.9846	-
19			14.27	0.9842	-
20			14.32	0.9842	-
21			14.74	0.9828	-
22			15.96	0.9825	-
23			15.53	0.9820	-
24			17.38	0.9791	-
25			17.98	0.9796	-
26			18.40	0.9784	-
27			18.52	0.9782	-
28			18.37	0.9777	-
29			19.84	0.9768	-
30			20.60	0.9755	-
31			20.77	0.9757	-
32			21.42	0.9752	FE
33			22.22	0.9743	AL
34			23.45	0.9727	-
35			25.29	0.9706	FE
36			27.79	0.9672	-
37			31.29	0.9627	-

COMMENTS:

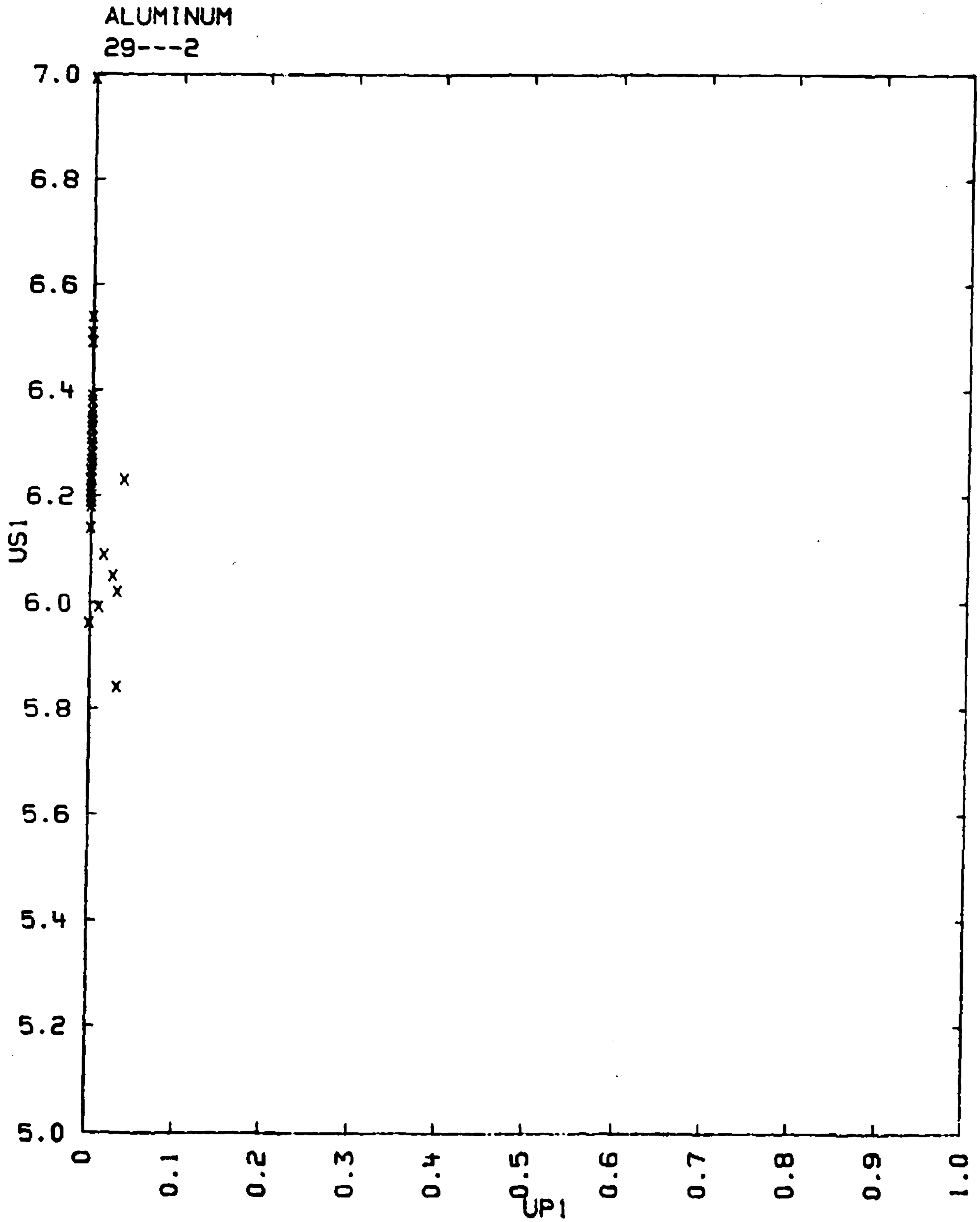
1) SOURCE: LUNDERGAN, C. D. AND HERRMANN, W.
J. APPL. PHYS. VOL. 34 P. 2046 (1963)

2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE A
STANDARD MATERIAL 6061-T6 ALUMINUM

3) 2UP IS THE ALUMINUM PROJECTILE VELOCITY. ** INDICATES EXPERIMENTS IN WHICH 4340 STEEL PROTECTILES WERE USED

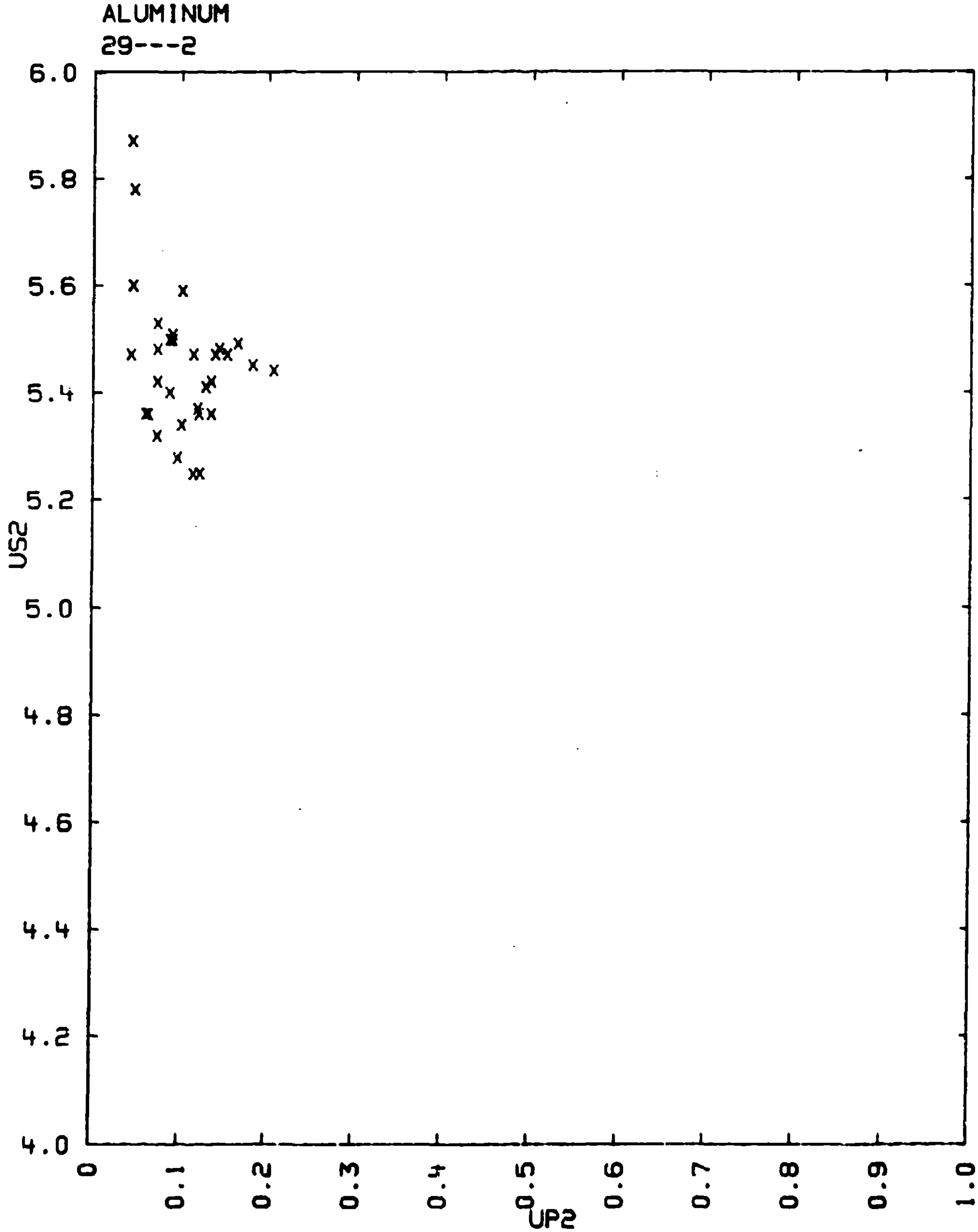
4) THE DIFFERENCE BETWEEN THE PROJECTILE VELOCITY (2UP) AND THE MEASURED UFS BEHIND THE SAMPLE RANGES FROM 0.001 AT 2.42 KILOBARS TO 0.047 AT 6.67 KBARS.

TABLE I



ALUMINUM
29---2
7.0
6.8
6.6
6.4
6.2
6.0
5.8
5.6
5.4
5.2
5.0
US1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP1

TABLE I



ALUMINUM
29---2
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
US2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP2

29---3
ALUMINUM

AL

VO = 0.369 CC/G.
VOI = 0.3715 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC. ST DESIGNATES THE STANDARD MATERIAL USED AS STRIKER. U(ST) IS THE VELOCITY OF STRIKER BEFORE IMPACT

TABLE

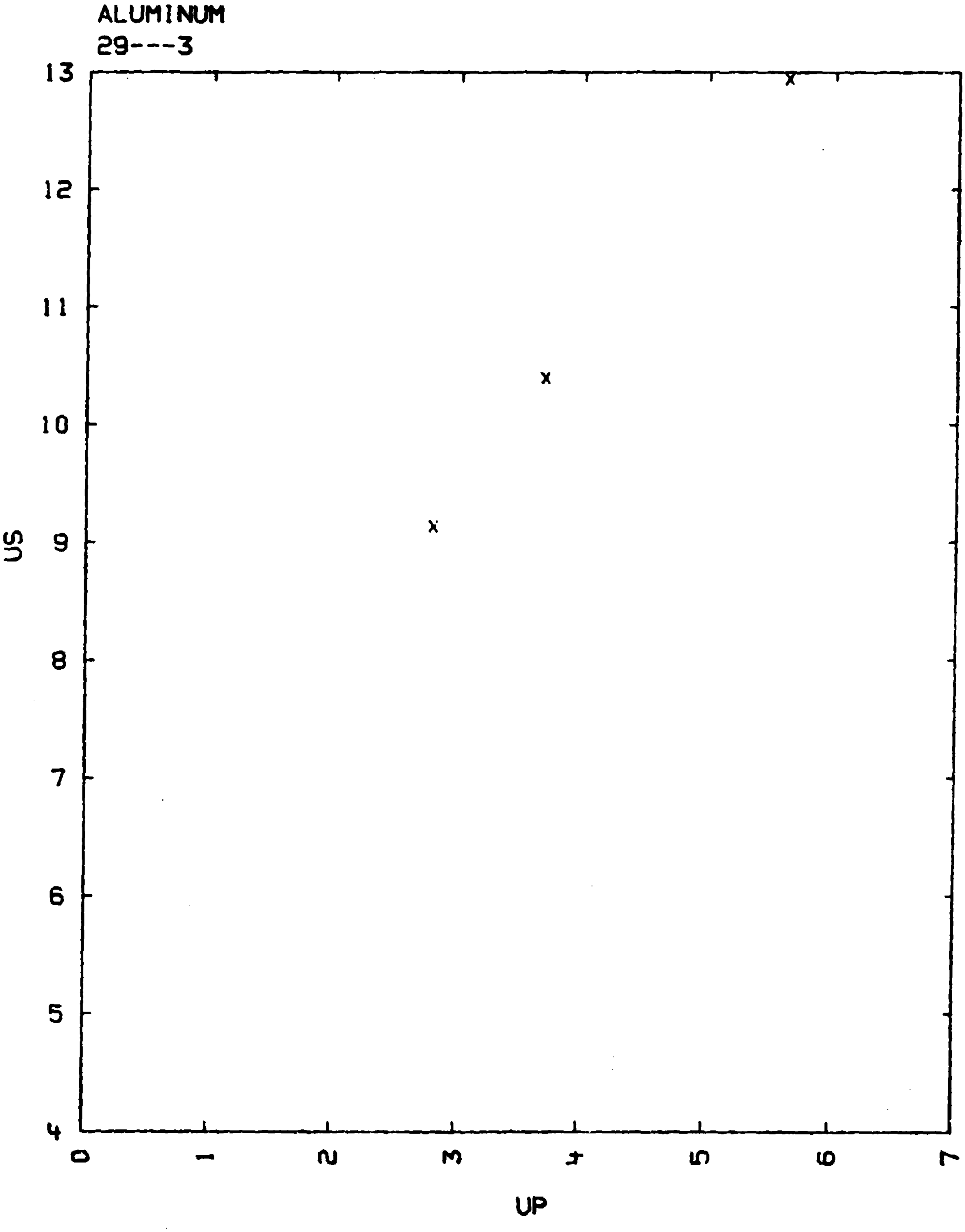
RHOO	US	UP	P	V/VO	ST	V(ST)
2.71	9.13	2.80	693	0.6935	AL	5.60
-	10.39	3.70	1042	0.6439	FE	5.60
-	12.94	5.62	1972	0.5659	FE	8.64

US = 5.38 + 1.35 UP KM/SEC.   FOR UP BETWEEN 2.80 TO 5.62 KM/SEC.
SIGMA US = 0.04 KM/SEC.

COMMENTS:

1) SOURCE: AL'TSHULER, L.V., KORMER, S.B., BAKANOVA, A.A.
AND TRUNIN, R.F.
SOVIET PHYS.-JETP, VOL. 11, P. 573 (1960)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION A
3) THE PRESSURES WERE PRODUCED BY AN EXPLOSIVELY ACCELERATED ALUMINUM OR STEEL PLATE AS INDICATED IN COLUMN 6.
4) THE INACCURACY IN THE DETERMINATION OF US AND UP DID NOT EXCEED 1.0 PERCENT. EACH POINT IS THE AVERAGE OF 4 TO 6 EXPERIMENTS.
5) VOI WAS OBTAINED FROM THE AMERICAN INSTITUTE OF PHYSICS HANDBOOK, (MCGRAW-HILL BOOK CO. 1963) 2 ED.

TABLE I



29---4
ALUMINUM POROUS

AL 92.5 PERCENT
AVERAGE GRAIN SIZE IS 1 MICRON

V01 = 0.3701 CC/G.
VO = 1/RHOO SEE TABLE

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURES IN KILOBARS AND DENSITY IN G/CC. ST DESIGNATES THE STANDARD MATERIAL AND THE MATERIAL OF THE STRIKER PLATE. U(ST) IS THE STRIKER VELOCITY BEFORE IMPACT. ST LABELS THE HUGONIOT VARIABLES OF THE IRON SAMPLE HOLDER.

TABLE

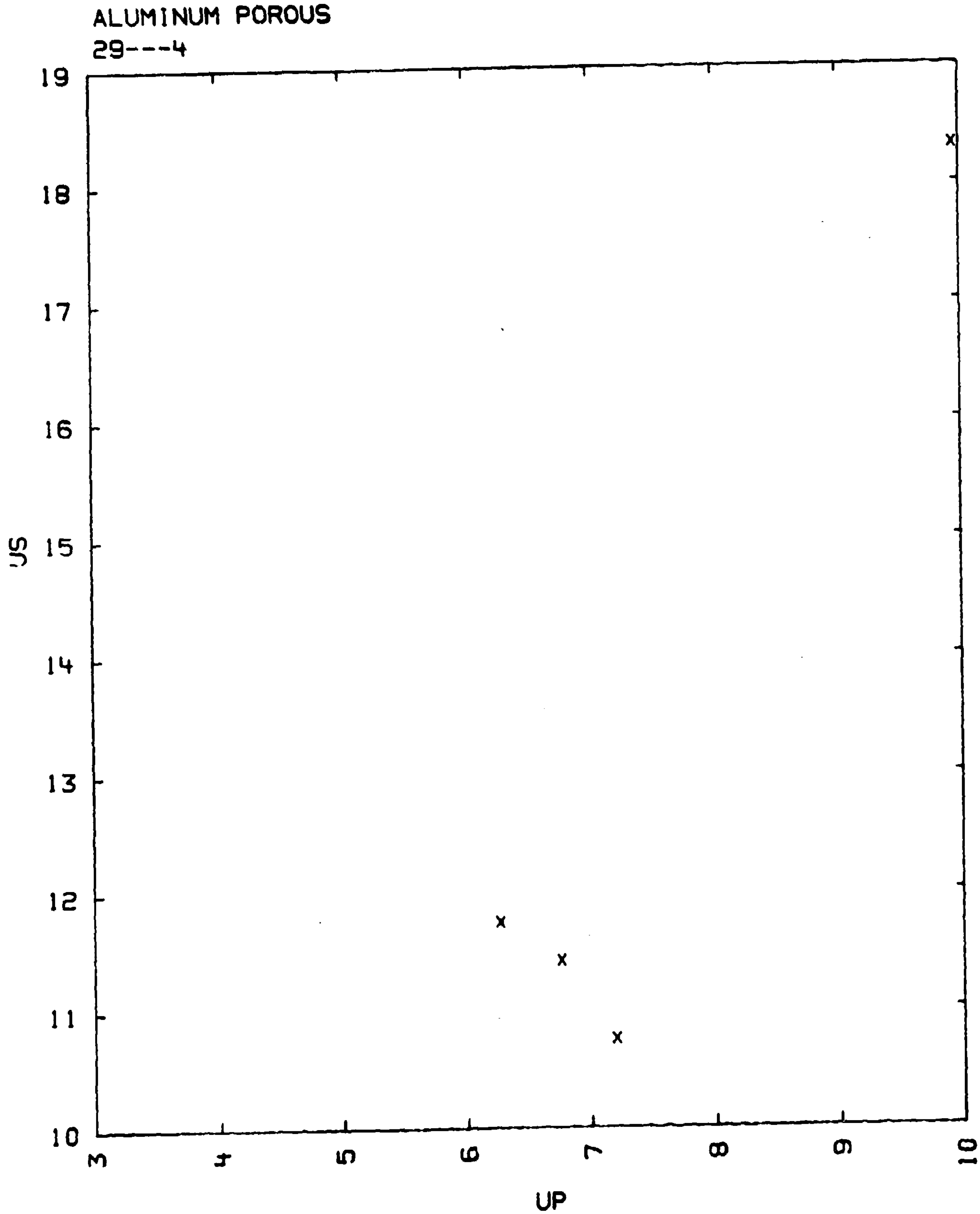
SAMPLE						DRIVER SYSTEM		
RHOO	US	SIG.US	UP	P	V/V01	U(ST)	US(ST)	UP(ST)
1.89	11.74	0.10	6.27	1391	0.6676	8.64	10.67	4.26
1.30	11.42	0.09	6.76	1003	0.8503	8.64	10.67	4.26
0.907	10.75	0.08	7.20	702	0.9852	8.64	10.67	4.26
2.70	18.31	0.16	9.94	4930	0.4577	15.45		

US =

COMMENTS:

1) SOURCE: KORMER, S.B., FUNTIKOV, A.I., URLIN, V.D.
AND KOLESNIKOVA, A.N.
SOVIET PHYS.-JETP, VOL. 15, P. 477 (1962)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE B
3) US IS THE AVERAGE DETERMINATION TAKEN FROM 4-8 EXPERIMENTS, EACH CONSISTING OF 4-6 READINGS.
5) V01 IS THE SPECIFIC VOLUME OF PURE ALUMUNUM OBTAINED FROM THE HANDBOOK OF CHEMISTRY AND PHYSICS (THE CHEMICAL RUBBER PUBLISHING CO., CLEVELAND, OHIO, 1962-1963) 44TH ED.
6) UP HAS NOT GIVEN BY THE SOURCE BUT CALCULATED FROM THEIR TABULATION.

TABLE I



ALUMINUM POROUS
29---4
US
UP
19
18
17
16
15
14
13
12
11
10
3
4
5
6
7
8
9
10

29---5
ALUMINUM

AL

V0 = 0.369 G/CC.
V0I = 0.370 G/CC.

THE TABLE BELOW GIVES THE VELOCITIES OF RELAXATION WAVES, C, AT VARIOUS PRESSURES. THE HUGONIOT STATE THE RELAXATION WAVE TRAVELS THROUGH IS GIVEN BY US, UP, P, OR V/V0. DENSITY IS GIVEN IN G/CC., VELOCITY IN KM/SEC. AND PRESSURE IN KILOBARS. ST DESIGNATES THE MATERIAL OF THE STRIKER PLATE, U(ST) IS THE VELOCITY BEFORE IMPACT AND US(ST) IS THE SHOCK VELOCITY IN THE PLATE AFTER IMPACT.

TABLE

SOUND VELOCITY
PARALLEL TO SHOCK DIRECTION

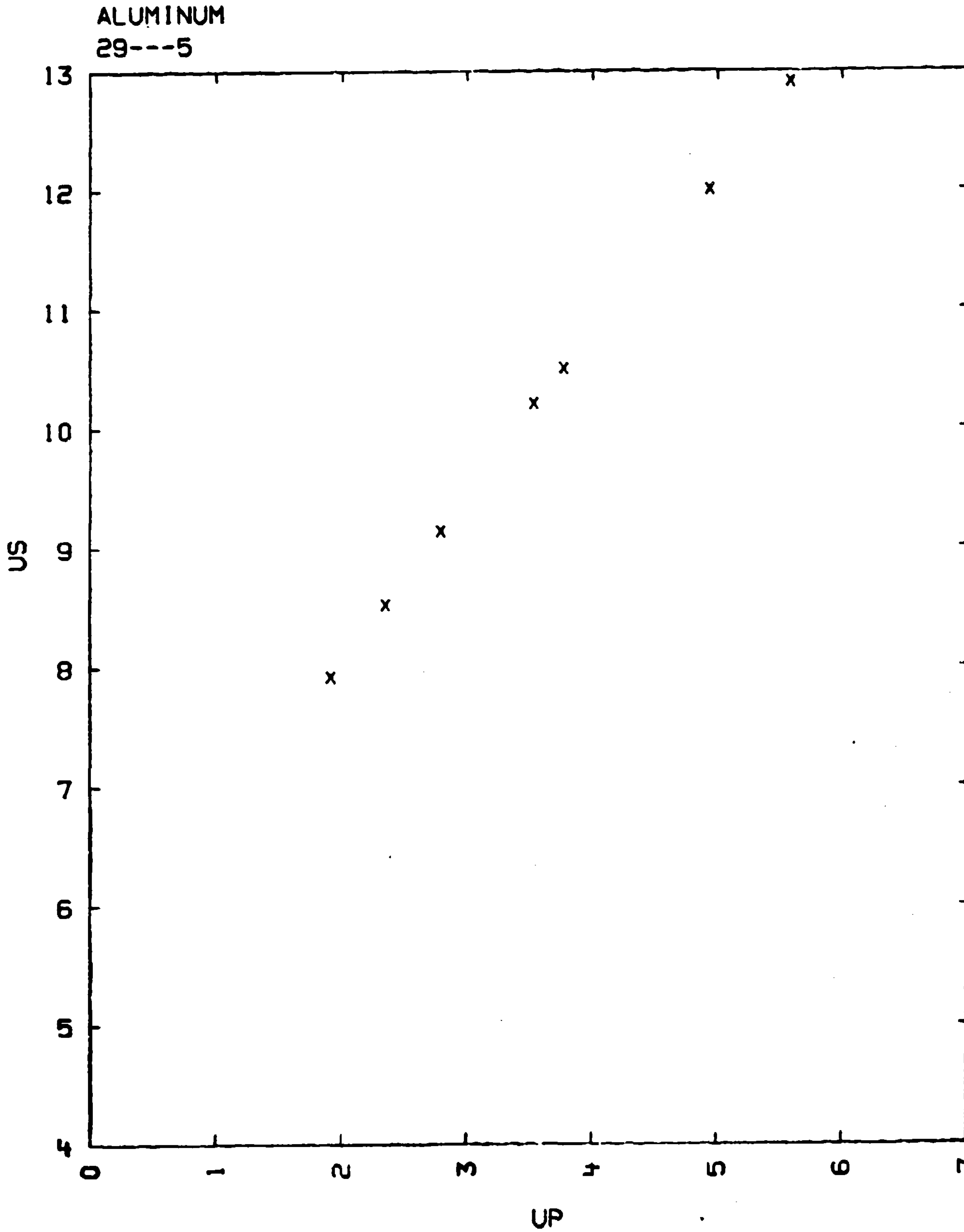
---HUGONIOT STATE--------						--DRIVER SYSTEM--		
RHO0	US	UP	P	V/V0	C	ST	U(ST)	US(ST)
2.71	9.13	2.80	693	0.6935		AL	5.60	9.13
-	8.52	2.35	545	0.7231	8.84	AL	5.60	9.13
-	7.92	1.92	412	0.7576	8.13	AL	5.60	9.13
-	10.5	3.77	1072	0.6406		FE	5.71	7.06
-	10.2	3.54	975	0.6519	9.76	FE	5.71	7.06
-	12.9	5.59	1955	0.5679	11.74	FE		
-	12.0	4.93	1600	0.5879	11.23	FE		

US =

COMMENTS:

1) SOURCE: AL'TSHULER, L. V., KORMER, S. B., BRAZHNIK, M. I., VLADIMIROV, L. A. AND FUNTIKOV, A. I. SOVIET PHYS.-JETP, VOL.11, P. 766 (1960)
2) EXPERIMENTAL TECHNIQUE A WAS USED FOR THE FIRST THREE ENTRIES. FOR ALL OTHER ENTRIES THE EXPERIMENTAL TECHNIQUE B WAS USED. THE HUGONIOT STATE WAS DETERMINED FROM ONE MEASURED PARAMETER AND THE KNOWN EQUATION OF STATE. AL'TSHULER ET AL, SOVIET PHYS-JETP, VOL. 11, P. 573 (1960).
3) THE SOUND VELOCITY WAS DETERMINED FROM THE ATTENUATION IN THE MEASURED SHOCK OR FREE SURFACE VELOCITY PRODUCED BY THE RAREFACTION WAVE ORIGINATING AT THE REAR SURFACE OF THE STRIKER PLATE.
4) THE MEASURED SOUND VELOCITY IS HIGHER THAN THE CALCULATED SOUND VELOCITY FOR A PURELY NONELASTIC SAMPLE.
5) V0I WAS OBTAINED FROM THE HANDBOOK OF CHEMISTRY AND PHYSICS (THE CHEMICAL RUBBER PUBLISHING CO. 1962-1963) 44TH ED.

TABLE I



29---6
ALUMINUM 2024 ALLOY

AL	93	PERCENT BY WEIGHT
CU	3.8 - 4.9	- - -
MG	1.2 - 1.8	- - -
MN	0.3 - 0.9	- - -
FE	< 0.5	- - -
SI	< 0.5	- - -
ZN	< 0.25	- - -
CR	< 0.1	- - -

V0 = 0.3591 CC/G

THE TABLE BELOW LISTS PRESSURE (P IN KILOBARS), PARTICLE- SHOCK- AND FREE SURFACE VELOCITY (UP, US AND UFS IN KM/SEC.) OF THE HUGONIOT. THIS HUGONIOT MAY BE CALCULATED FROM THE LINEAR FIT BELOW THE TABLE. THE OTHER COLUMNS ARE THE COEFFICIENTS OF THE FIT TO THE ISENTROPIC CURVES

P = A0 + A1*(UFS-U) + A2*(UFS-U)**2------ +A4*(UFS-U)**4

WHICH IN THE P VS U PLANE PASS THROUGH THE HUGONIOT AT THE LISTED POINTS THE DENSITY AT THE FOOT OF THE HUGONIOT IS 2.785 G/CC.

TABLE

US	UP	UFS	P	A0	A1	A2	A3	A4
5.489	0.100	0.200	15.3	0.0	149.38	36.73	-0.160	0.170
6.834	1.100	2.210	209.4	0.0	147.71	36.89	-0.291	0.183
7.910	1.900	3.848	418.6	0.0	143.57	36.75	-0.456	0.196
8.717	2.500	5.168	606.9	-9.25	135.60	35.14	-0.169	0.149
9.524	3.100	6.566	822.3	-23.66	122.26	34.25	-0.229	0.140
10.197	3.600	7.752	1022.3	-33.53	110.97	33.43	-0.283	0.131

US = 5.3550 + 1.345 UP KM/SEC.

COMMENTS:

1) SOURCE: MARSH, S. P.
PRIVATE COMMUNICATION
GMX-6, LOS ALAMOS SCIENTIFIC LABORATORY
LOS ALAMOS, NEW MEXICO.

2) DATA REDUCTION METHOD: D
THE ISENTROPES WERE CALCULATED WITH A CONSTANT VALUE OF 0.1620 CC/G FOR THE PARTIAL DERIVATIVE AT CONSTANT VOLUME (DE/DP). E = INTERNAL ENERGY AND P = PRESSURE.

3) THE ACCURACY OF THE FIT TO THE COMPUTER OUTPUT FROM THE ABOVE SOURCE IS AS FOLLOWS:

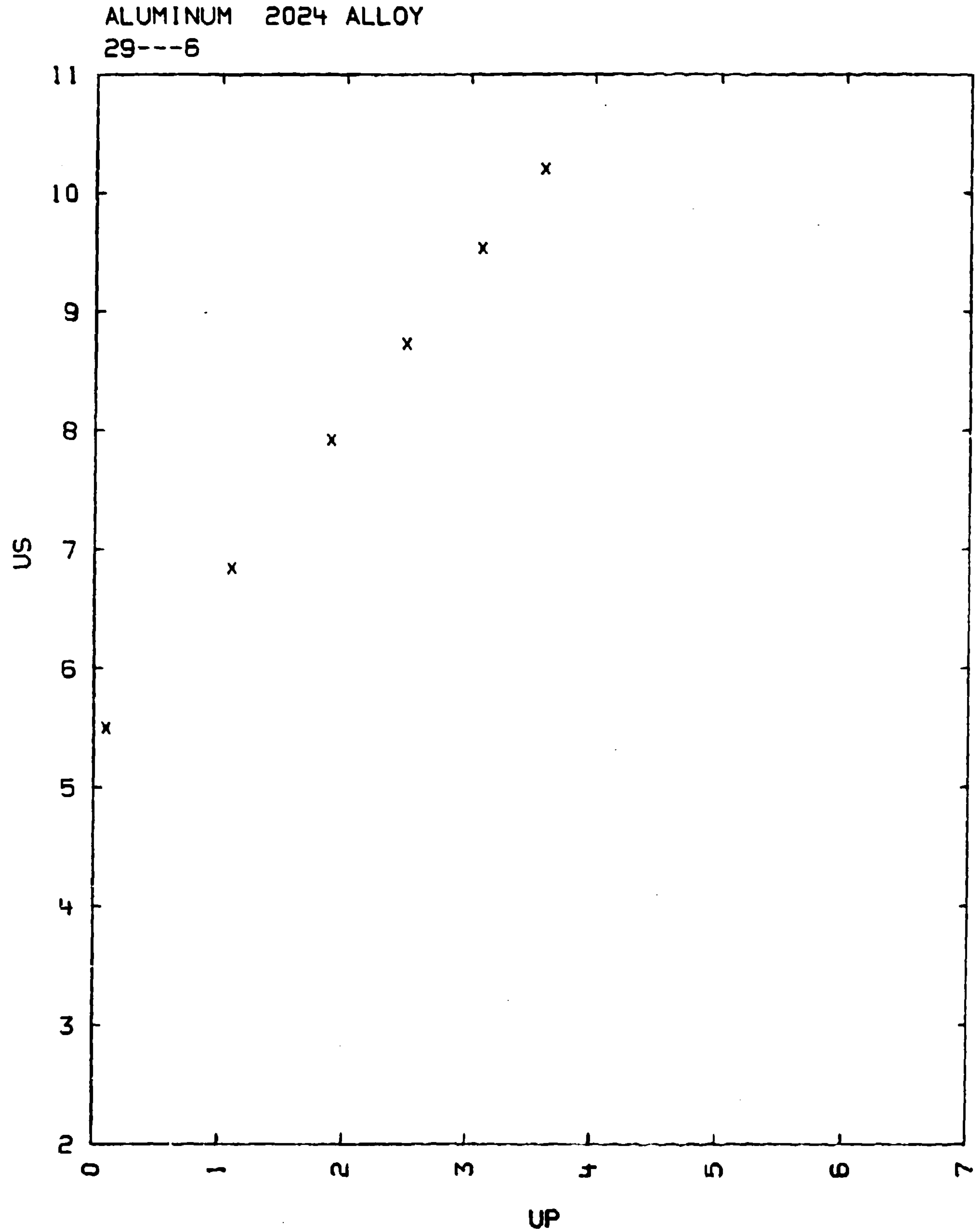
A DEVIATION OF LESS THAN 0.03 KBAR FOR THE FIRST ADIABAT
- - - - - 0.10 - - - SECOND -
- - - - - 0.13 - - - THIRD -
- - - - - 0.24 - - - FOURTH - ABOVE 10 KB
- - - - - 0.03 - - - - - - 33 -
- - - - - 0.24 - - - FIFTH - - 31 -

-	-	-	-	-	0.03	-	-	-	-	-	-	54	-
-	-	-	-	-	0.2	-	-	-	SIXTH	-	-	50	-
-	-	-	-	-	0.03	-	-	-	-		-	76	-

4) THE FIT FOR THE LAST THREE ADIABATS WAS IMPROVED BY ALLOWING A NON-ZERO INTERCEPT. THE DEVIATION AT UFS-U = 0 IS THEREFORE THE VALUE OF THIS INTERCEPT. THIS ERROR DECREASES NEARLY LINEARLY TO THE LARGER UNCERTAINTY LISTED ABOVE.

5) THE MAXIMUM PRESSURE TO WHICH THE ABOVE FITS ARE VALID RANGE FROM 1100 KBARS FOR THE FIRST LINE TO 1250 KBARS FOR THE LAST TABLE ENTRY

TABLE I



29---7

ALUMINUM 2024 ALLOY

AL	93	PERCENT	BY	WEIGHT
CU	3.8 - 4.9	-	-	-
MG	1.2 - 1.8	-	-	-
MN	0.3 - 0.9	-	-	-
FE	<0.5	-	-	-
SI	<0.5	-	-	-
ZN	<0.25	-	-	-
CR	<0.1	-	-	-

V0 = 0.3591 CC/G   CL = 6.300 KM/SEC   C0 = 5.339 KM/SEC
                     CS = 2.895 KM/SEC

THE TABLE BELOW LISTS PRESSURE (P IN KILOBARS), PARTICLE- SHOCK- AND FREE SURFACE VELOCITY (UP, US AND UFS IN KM/SEC.) OF THE HUGONIOT. THIS HUGONIOT MAY BE CALCULATED FROM THE LEAST SQUARE FIT BELOW THE TABLE. OTHER COLUMNS ARE THE COEFFICIENTS OF THE FIT TO THE ISENTROPIC CURVES

P = A1*(UFS-U) + A2*(UFS-U)**2------ +A5*(UFS-U)**5

WHICH IN THE P VS U PLANE PASS THROUGH THE HUGONIOT AT THE LISTED POINTS THE DENSITY AT THE FOOT OF THE HUGONIOT IS 2.785 G/CC.

TABLE

US	UP	UFS	P	A1	A2	A3	A4	A5
6.307	0.688	1.381	120.8	146.677	40.576	-0.969	-0.1114	
6.919	1.140	2.294	219.7	145.945	38.828	-0.016	-0.2619	
7.257	1.398	2.828	282.5	141.834	43.640	-5.966	2.5537	-0.4384
7.624	1.681	3.417	356.8	138.206	44.767	-7.214	3.0070	-0.4781
8.026	1.993	4.080	445.3	133.033	45.229	-7.609	3.0555	-0.4528
8.478	2.341	4.839	552.6	125.740	45.017	-7.537	2.9445	-0.4056
8.730	2.532	5.267	615.5	121.215	44.160	-6.932	2.6771	-0.3529
9.154	2.846	5.977	725.4	113.401	43.276	-6.570	2.4953	-0.3055
9.478	3.079	6.538	812.5	104.909	43.985	-7.959	2.9091	-0.3302
9.850	3.337	7.153	915.2	97.414	43.155	-7.982	2.8328	-0.2993
10.293	3.631	7.899	1040.3	87.492	41.468	-7.955	2.6758	-0.2534
10.553	3.796	8.312	1115.2	83.355	40.218	-7.660	2.5273	-0.2275

US = 5.300 + 1.550*UP - 0.1442*UP**2 + 0.02648*UP**3 KM/SEC

COMMENTS

1) SOURCE: COMPILER
EQUATION OF STATE FILE
LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIFORNIA.

2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION METHOD D

OVER

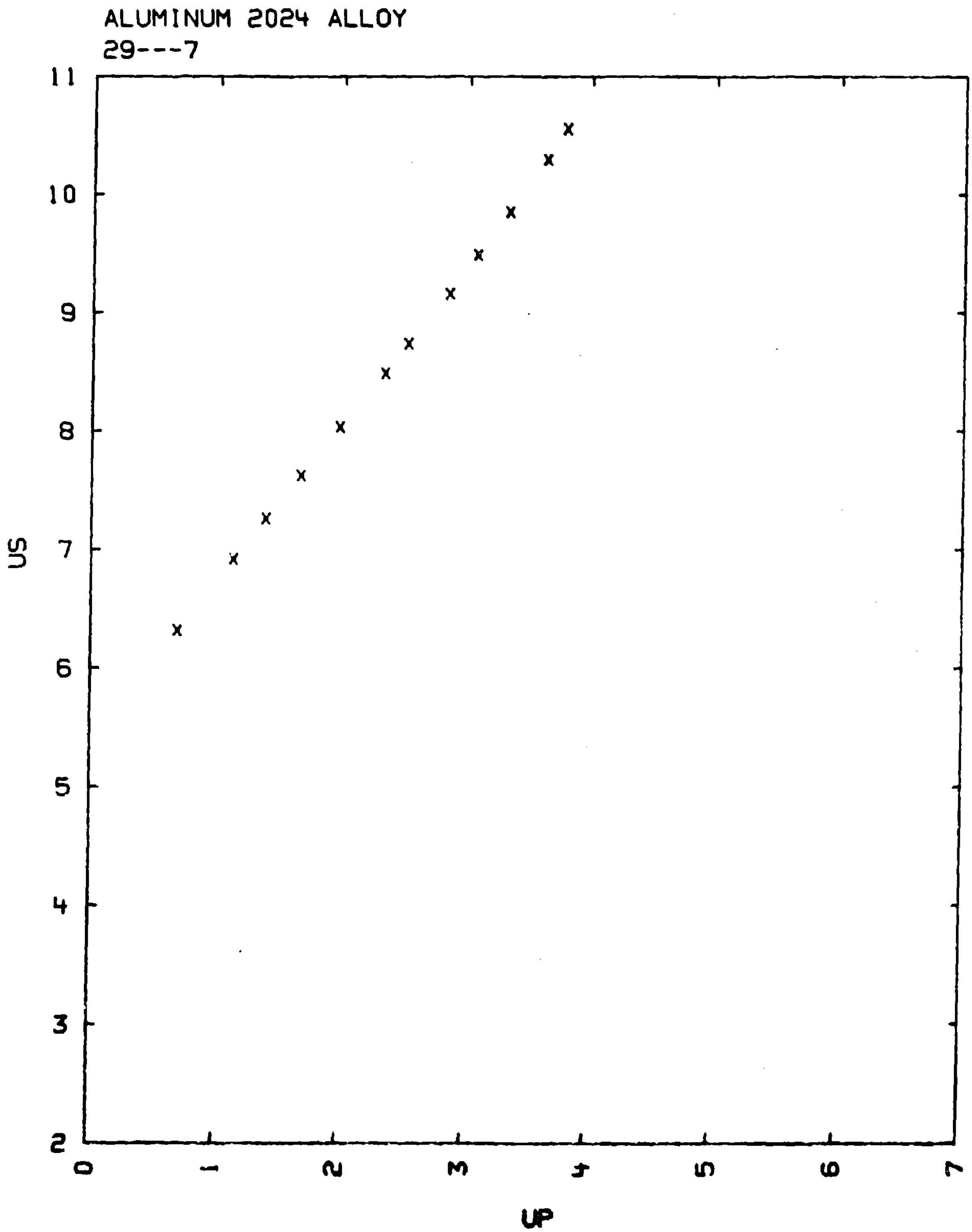
THE VALUE O[illegible] DERIVATIVE AT CONSTANT VOLUME:
V(DP/DE) [illegible] 4.313 - 1.4275*RHO - 0.77141*RHO**2 + 0.169378*RHO**3
WAS OBTAINED BY USING THE DUGDALE MCDONALD EQUATION FOR THE GRUNEISEN GAMMA IN THE METHOD OF
J. M. WALSH ET AL

PHYS. REV., VOL. 108, P. 196, (1957)

3) THE ACCURACY OF THE TABULATED LEAST SQUARE FIT TO THE COMPUTER OUTPUT OF P AND (UFS-U) IS BETTER THAN 0.2 KBAR. THE CALCULATION USED ABOUT 200 EXPERIMENTAL POINTS.

4) THE PRESSURE RANGE OVER WHICH THE TABULATED FITS ARE VALID RANGES FROM 0 TO 900 KBAR FOR THE FIRST ENTRY AND UP TO 1300 KBARS FOR THE LAST ENTRY.

TABLE 1



29---8
ALUMINUM AU4G ALLOY

AL = 92.9 PERCENT BY WEIGHT
CU = 4.0 - - -
MG = 1.2 - - -
MN = 1.3 - - -
SI = 0.6 - - -

VO = 0.356-0.357 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

RHOO	US	UP	UFS	P	V/VO
2.80	7.309	1.374	2.747	281	0.812
-	7.142	1.400	2.799	280	0.804
-	7.353	1.381	2.762	284	0.812
-	7.353	1.381	2.762	284	0.812
-	7.143	1.592	3.184	318	0.777
-	7.396	1.539	3.078	319	0.792
-	7.235	1.501	3.001	304	0.793
-	7.564	1.590	3.180	337	0.790
-	7.032	1.377	2.753	271	0.804
-	7.032	1.402	2.803	276	0.801
-	7.310	1.429	2.857	293	0.805
-	7.386	1.449	2.897	300	0.804
-	7.032	1.227	2.453	242	0.828
-	7.032	1.209	2.418	238	0.825
-	6.983	1.237	2.473	242	0.823
-	7.143	1.265	2.530	253	0.823
-	7.299	1.446	2.892	296	0.802
-	7.386	1.428	2.855	295	0.806
-	7.496	1.447	2.896	306	0.808
-	7.331	1.519	3.038	312	0.792
2.81	7.194	1.235	2.469	250	0.828
-	7.112	1.240	2.479	248	0.826
-	7.022	1.241	2.482	245	0.823
-	7.257	1.209	2.418	247	0.833
-	6.859	1.213	2.426	234	0.823
-	6.793	1.116	2.232	213	0.836
-	6.451	0.972	1.944	176	0.849
-	6.451	0.938	1.875	170	0.855
-	6.321	0.725	1.449	129	0.885
-	6.321	0.738	1.476	131	0.883
-	6.427	0.638	1.275	115	0.901
-	6.361	0.634	1.267	113	0.900
-	6.410	0.636	1.272	115	0.901
-	6.410	0.646	1.291	116	0.899
-	6.265	0.700	1.393	123	0.888
-	6.321	0.711	1.421	126	0.888
-	6.127	0.715	1.430	123	0.883
-	6.127	0.735	1.469	127	0.880

ALUMINUM AU4G ALLOY

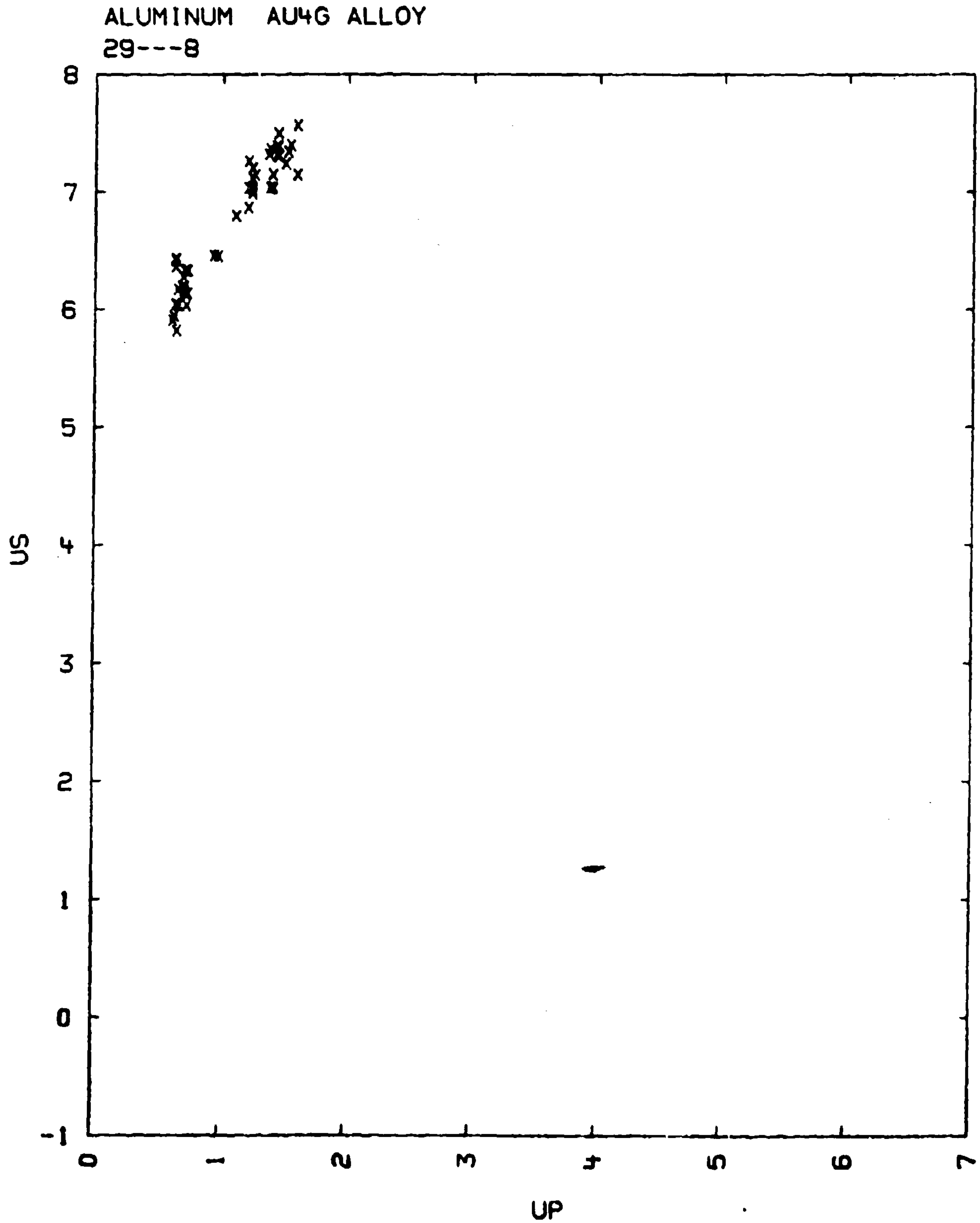
RHOO	US	UP	UFS	P	V/VO
-	6.024	0.659	1.318	112	0.891
-	5.807	0.654	1.307	107	0.887
-	6.045	0.639	1.277	109	0.894
-	5.938	0.632	1.263	105	0.894
-	6.188	0.708	1.416	123	0.886
-	6.188	0.693	1.386	121	0.880
-	6.180	0.690	1.379	120	0.888
-	6.180	0.695	1.390	121	0.888
-	6.031	0.721	1.441	122	0.880
-	6.150	0.708	1.416	122	0.885
-	6.165	0.657	1.314	114	0.893
-	6.165	0.647	1.293	112	0.895
-	5.903	0.622	1.244	103	0.895
-	5.903	0.622	1.244	103	0.895

US =

COMMENTS:

1) SOURCE: BERGER J. AND FAUQUIGNON C.
PRIVATE COMMUNICATION (1964), B.P. NO. 7, SEVRAN, FRANCE
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE D
UP WAS DETERMINED BY USING THE FREE-SURFACE APPROXIMATION WHERE:
UFS = 2UP
3) SAMPLE DIMENSIONS FOR THE US MEASUREMENTS: 2.0 CM DIAMETER
0.5 CM THICKNESS
SAMPLE DIMENSIONS FOR THE UFS MEASUREMENTS: 2.0 CM DIAMETER
0.25 CM THICKNESS

TABLE I



29---9
ALUMINUM POROUS

AL 99.6 WT PERCENT
CU, FE AND MN TOTAL 0.4 WT PERCENT
PARTICLE SIZE: ABOUT 4 MICRON. SEE COMMENTS

VO = 0.55 - 0.75 CC/G
VOI= 0.3715 CC/G

THE TABLE LISTS DENSITY IN G/CC, VELOCITIES IN KM/SEC AND PRESSURE IN KBAR. U(ST) DESIGNATES THE VELOCITY OF THE 1100 ALUMINUM PROJECTILE

TABLE I

RHOO	US	UP	P	V/VO	U(ST)
1.816	3.23	1.197	70.22	0.630	1.64
-	2.97	1.206	65.07	0.594	1.62
-	3.94	1.425	102.0	0.638	2.04
-	4.28	1.543	119.9	0.640	2.25
-	5.00	1.901	172.6	0.619	2.86

US = -0.128 + 2.76*UP KM/SEC
SIGMA US = 0.13 KM/SEC

TABLE II

RHOO	US	UP	P	V/VO	U(ST)
1.348	2.63	1.323	46.9	0.497	1.63
-	2.65	1.329	47.5	0.498	1.64
-	3.50	1.772	83.7	0.494	2.29
-	4.38	2.179	128.7	0.502	2.93

US = -0.057 + 2.03*UP KM/SEC
SIGMA US = 0.030 KM/SEC

COMMENTS:

1) SOURCE: MORGAN D. T., ROCKOWITZ M., ATKINSON A. L.
AVCO CORP. REPORT NO. AFWL-TR-65-117
RESEARCH AND DEVELOPMENT DIVISION
AVCO CORP., WILMINGTON, MASS., USA
2) EXPERIMENTAL TECHNIQUE: (SEE 3)
DATA REDUCTION METHOD: B
THE STANDARD MATERIAL WAS 1100 AL ALLOY WITH
RHOO =2.70 G/CC, US = C + S*UP KM/SEC
C = 5.144 +OR-0.093 KM/SEC
S = 1.528 +OR-0.041
3) THE PRESSURE WAS GENERATED WITH ALUMINUM 1100 ALLOY PROJECTILES
THE PROJECTILE VELOCITY AND SAMPLE SURFACE MOTION WERE DETECTED BY

REFLECTING A LASER BEAM OFF THESE SURFACES AND OBSERVING THE LIGHT THROUGH A SET OF SLITS PHOTOMETRICALLY. THESE MEASUREMENTS TOGETHER WITH THE OBSERVATION OF AN IMPACT FLASH GENERATED WHEN THE PROJECTILE AND SAMPLE COLLIDE, YIELD US AND U(ST)

4) ACCURACY OF THE VELOCITY MEASUREMENTS WAS TYPICALLY 1 PERCENT

TABLE I

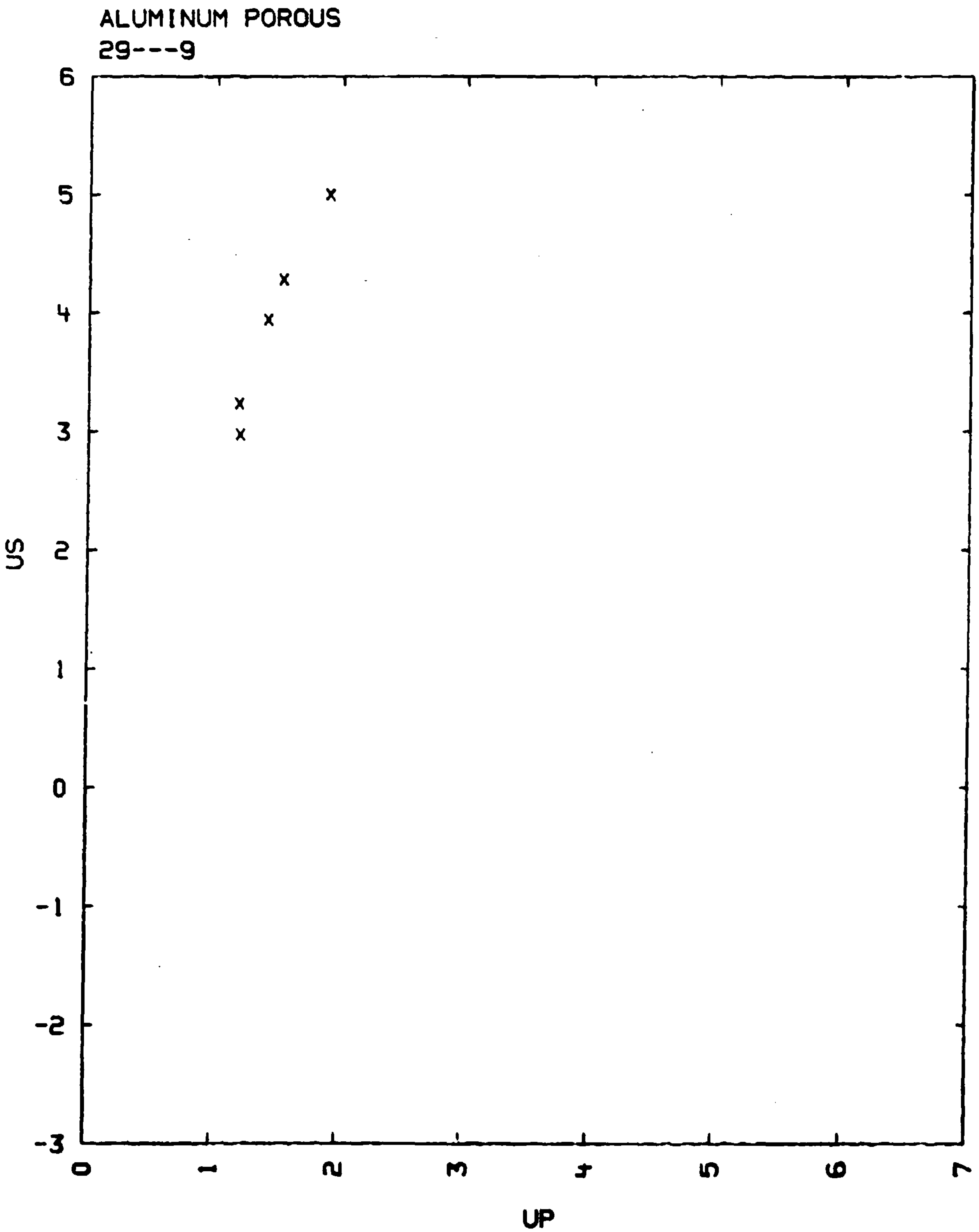
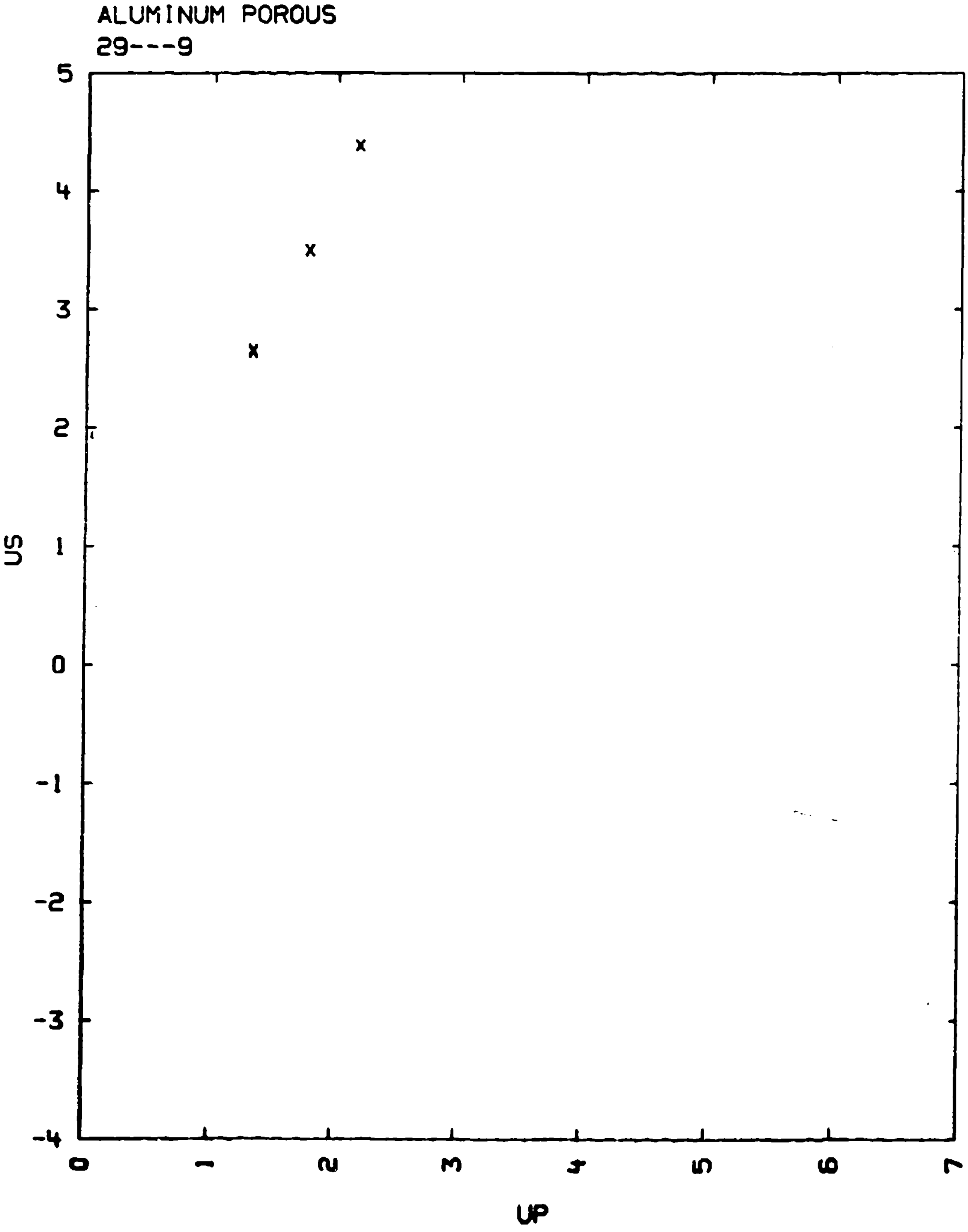


TABLE II



29---10
ALUMINUM POROUS

AL 100 PERCENT
PARTICLE SIZE: 0.208 MM MAX. 0.030 MM AVERAGE IN TABLES I AND II
0.300 MM MAX 0.208 MM MIN. IN TABLE III

TABLE I, II AND III GIVE THE EXPERIMENTAL HUGONIOT POINTS FOR SAMPLES OF COMPRESSED POWDER AT VARIOUS DENSITIES. DENSITY IS GIVEN IN G/CC, VELOCITIES IN KM/SEC AND PRESSURE IN KILOBARS.

V0 = 0.519-0.521 CC/G

TABLE I

- - - - - - - - SAMPLE				- - - - - - - - - - - -		STANDARD
RHOO	US	UP	UFS	P	V/V0	UFS(ST)
1.93	5.08	1.88	3.238	184	0.630	2.89
1.930	5.17	1.89		189	0.634	
-	5.36	1.84		191	0.657	
1.927	6.43	2.45		304	0.619	
1.930	6.83	2.70		357	0.605	
-	6.90	2.77		368	0.598	
1.92	7.15	3.03	5.43	418	0.576	5.07C
1.92	7.79	3.42	5.93	511	0.561	5.86
1.919	7.97	3.45		528	0.567	

US = 2.08 + 1.71*UP KM/SEC.
SIG US = 0.15 KM/SEC.

V0 = 0.629-0.635 CC/G

TABLE II

- - - - - - SAMPLE				- - - - - - - - - - -		STANDARD
RHOO	US	UP	UFS	P	VOVO	UFS(ST)
1.590	5.43	2.43	3.968	210	0.552	3.56
1.585	5.82	2.67	4.148	246	0.540	3.96
1.590	5.93	2.69	4.53	254	0.547	4.02
1.587	6.58	3.05	5.21	319	0.536	4.67
1.590	6.50	3.06	5.25	316	0.529	4.67
1.585	6.83	3.20	5.53	347	0.531	4.97
1.585	6.90	3.25	5.52	355	0.529	5.04
1.580	6.91	3.26	5.258	356	0.528	5.07C
1.587	7.29	3.44	5.95	397	0.528	5.43
1.585	7.49	3.58		426	0.523	5.72
1.575	7.55	3.66	6.24	436	0.519	5.86

ALUMINUM POROUS

RHOO	US	UP	UFS	P	VOVO	UFS(ST)

US = 1.12 + 1.78*UP KM/SEC
SIGMA US = 0.044 KM/SEC

VO = 0.740-0.744 CC/G

TABLE III

- - - - - - - SAMPLE	- - - - -	- - - - - -				STANDARD
RHOO	US	UP	UFS	P	V/VO	UFS(ST)
1.350	5.09	2.58	4.518	177	0.493	3.56
-	5.57	2.82	4.168	212	0.494	3.96
-	5.64	2.85	5.11	218	0.495	4.02
1.350	6.72	3.37	6.08	305	0.498	4.97
1.351	6.79	3.41	5.848	313	0.498	5.04
1.350	7.16	3.60	6.85	348	0.497	5.43
1.344	7.29	3.85		377	0.472	5.84
1.350	7.32	3.78		373	0.484	5.72

US = 0.426 + 1.83*UP KM/SEC
SIGMA US = 0.12 KM/SEC

TABLE IV SUMMARIZES THE RESULTS OF SOME SHOCKS THAT WERE REFLECTED FROM A TUNGSTEN COVER. RHOO IN G/CC, P IN KBAR AND E IN KBAR*CC/G

TABLE IV

RHOO	P1	V1/VO	E1-EO	P2	V2/VO	E2-EO
1.587	.319	0.536	46.6	984	0.428	92.5
1.585	426	0.523	64.1	1261	0.414	124.0
1.331	373	0.479	71.0	1244	0.375	135.8

COMMENTS:

1) SOURCE: ANDERSON, G. D., DORAN, D. G. AND FAHRENBRUCH, A. L.
AIR FORCE WEAPONS LAB. REPORT: AFWL-TR-65-147 (1965)
- - - - - AFWL-TR-67-43
STANFORD RES. INST., MENLO PARK, CALIFORNIA, U.S.A.
2) EXPERIMENTAL METHOD C
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 2024 ALUMINUM
3) AVERAGE PARTICLE SIZE OF 0.030 MM. THE SIZE LIMITS GIVEN ABOVE WERE OBTAINED BY APPROPRIATELY SIEVING THE POWDER BEFORE PRESSING.
4) SAMPLE DIMENSIONS: 3.8 CM DIAMETER BY 0.48 CM THICK

5) IN TABLE I, II AND III:
C REFERS TO CASES WHERE THE UFS OF THE STANDARD HAS CALCULATED FROM ITS MEASURED SHOCK VELOCITY AND ITS KNOWN EQUATION OF STATE.
B REFERS TO EXPERIMENTS IN WHICH THE SURFACE OF THE SAMPLE HAS COVERED BY AN ALUMINUM SHIM.

TABLE I

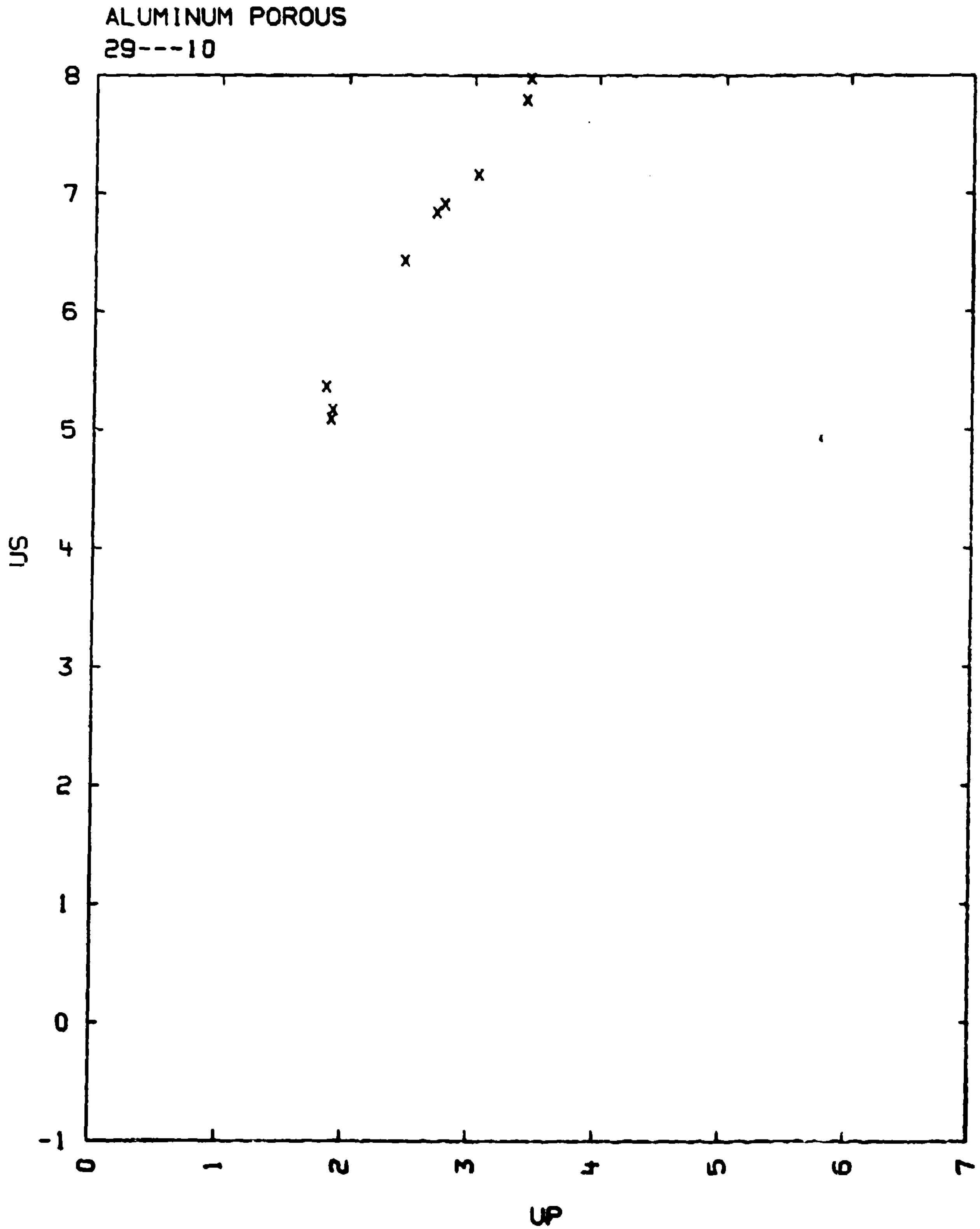


TABLE II

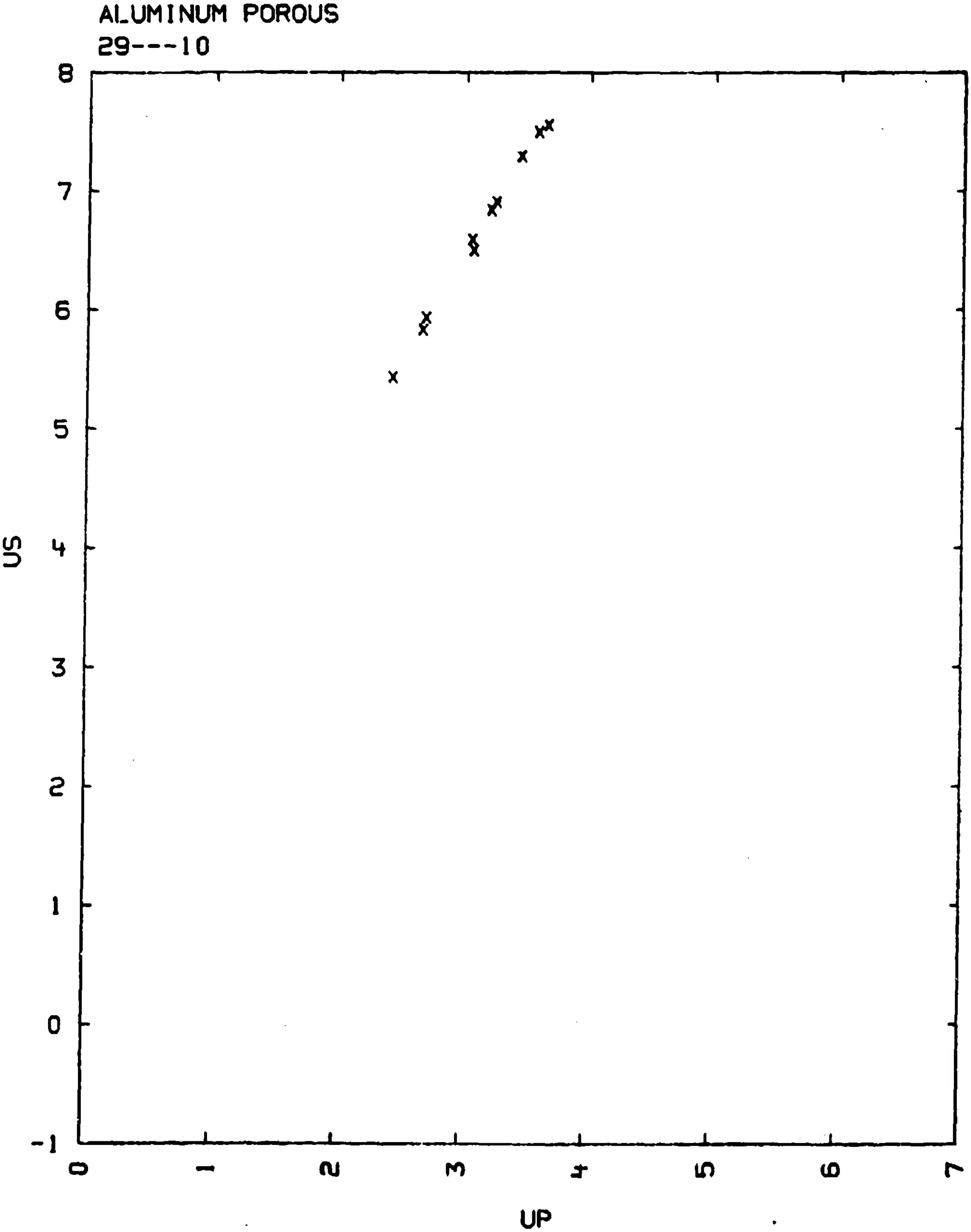
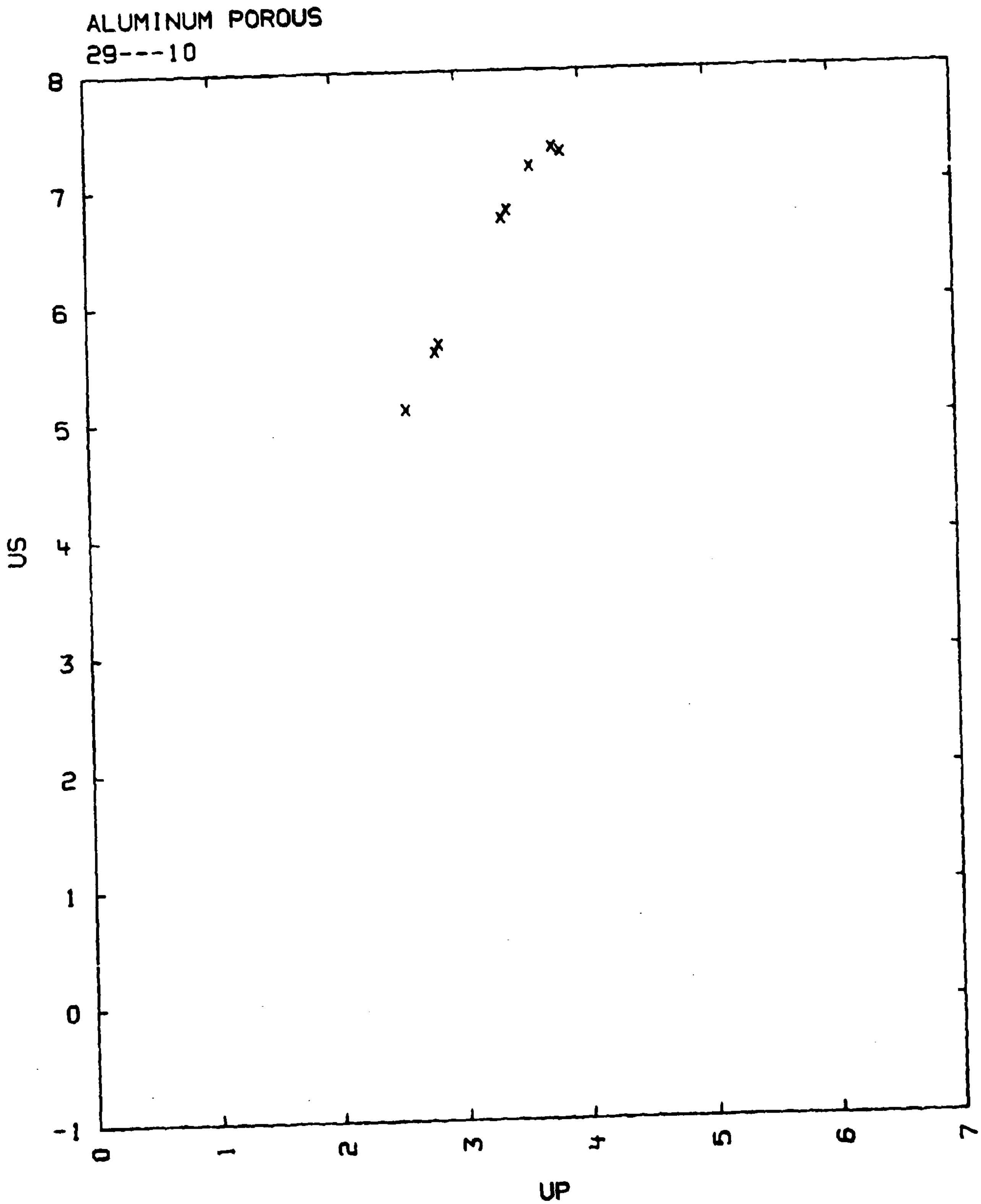


TABLE III



29---11
ALUMINUM 1060 ALLOY

SILICON	SI	0.25	WT	PERCENT	MAX.
IRON	FE	0.35	-	-	-
COPPER	CU	0.05	-	-	-
MANGANESE	MN	0.03	-	-	-
MAGNESIUM	MG	0.03	-	-	-
ZINK	ZN	0.05	-	-	-
TITANIUM	TI	0.03	-	-	-
OTHER		0.03	-	-	-
ALUMINUM	AL	REMAINDER			

V0 = 0.370 CC/G
V0I= 0.3706 CC/G

THE TABLE BELOW LISTS DENSITY IN G/CC. VELOCITIES IN KM/SEC AND PRESSURE IN KILOBARS

TABLE I

------	SAMPLE	----------					STANDARD
T0	RHO0	US	UP	UFS	P	V/V0	UFS
17	2.70	7.31	1.45	2.97	286	0.802	2.89
-	-	7.75	1.80		377	0.767	3.60
-	-	8.77	2.46		583	0.718	5.03
-	-	9.06	2.58	5.42	633	0.716	5.35
-	-	9.13	2.71		667	0.702	5.61
-	-	8.76	2.77	5.48	656	0.684	*
-	-	8.82	2.70	5.14	647	0.694	*
17	-	8.14	2.21	4.56	486	0.728	*
542	2.580	8.82	2.79	5.47	636	0.684	*
555	2.586	8.56	2.76	5.27	611	0.678	*
543	2.586	8.24	2.23	4.66	475	0.729	*

US = 5.39 + 1.32*UP KM/SEC FOR THE COLD SAMPLES
SIGMA US = 0.20 KM/SEC

COMMENTS:

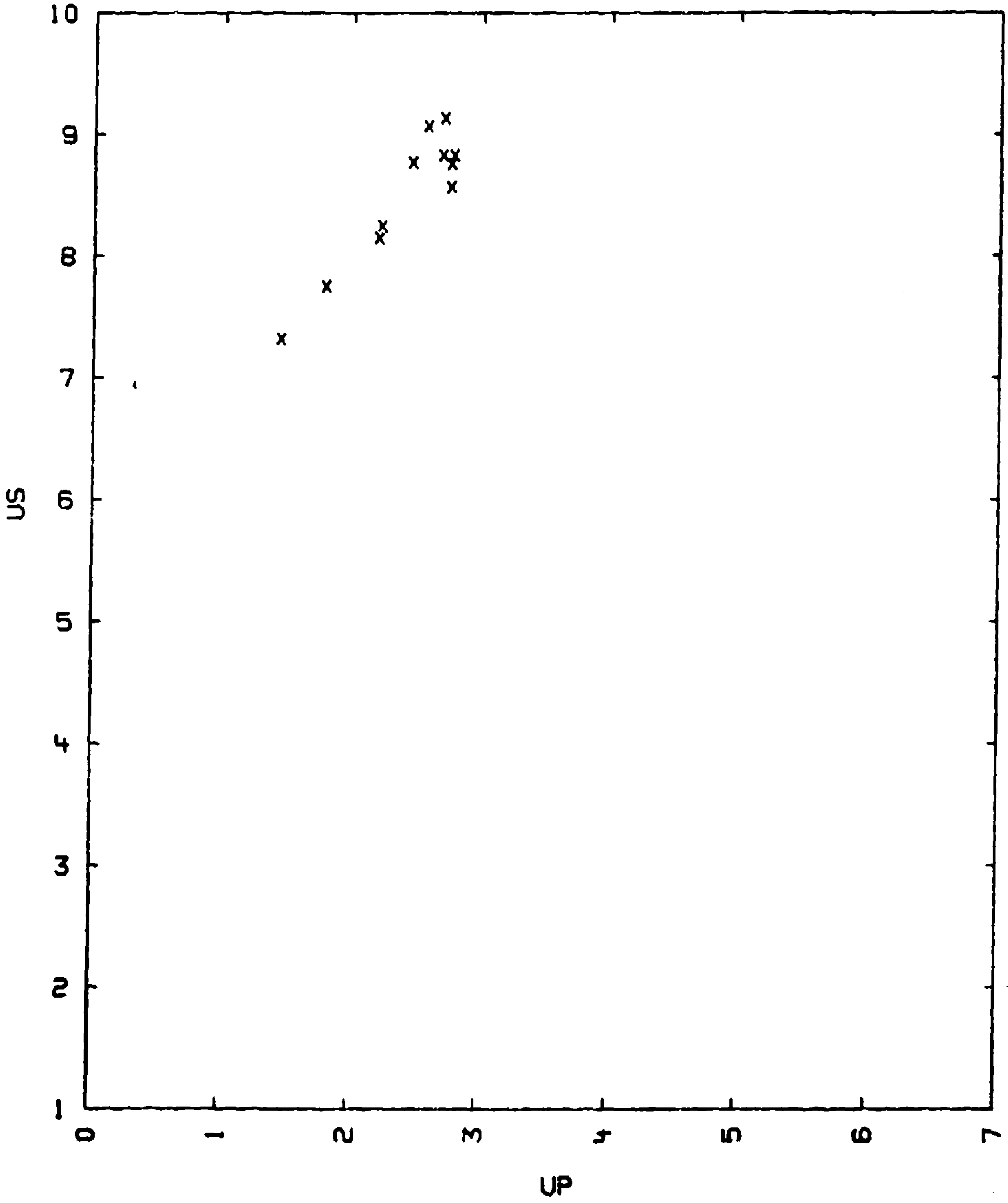
1) SOURCE: ANDERSON, G.D., DORAN, D.G. AND FAHRENBRUCH, A.L.
AIR FORCE WEAPONS LAB REPORT AFWL-TR-65-147 (1965)
STANFORD RES. INST., MENLO PARK, CALIFORNIA
2) EXPERIMENTAL METHOD C
DATA REDUCTION TECHNIQUE B AND A (FOR THE ROWS WITH * IN THE UFS COLUMN)

STANDARD MATERIAL 2024 ALUMINUM EXCEPT FOR THE ROWS MARKED WITH A * WHERE BRASS WAS USED. NO PARAMETER WAS LISTED FOR THIS MATERIAL

3) SAMPLE DIMENSIONS: 3.8 CM DIAMETER BY 0.48 CM THICK.

TABLE I

ALUMINUM 1060 ALLOY
29---11



29---12
ALUMINUM 2024-T4

SI	0.50	WT	PERCENT	MAX.	
FE	0.50	-	-	-	
CR	0.10	-	-	-	
ZN	0.25	-	-	-	
OTHERS	0.15	-	-	-	
CU	3.8-4.9	WT	PERCENT		
MN	0.3-0.9	-	-		
MG	1.3-1.8	-	-		

VO = 0.3579 CC/G   CL = 6.30 KM/SEC

THE TABLE LISTS DENSITY IN G/CC VELOCITIES IN KM/SEC AND PRESSURES IN KBARS. SUBSCRIPTS 1 AND 2 REFER TO AN ELASTIC PRECURSOR AND THE MAIN WAVE.

TABLE

RHOO	US1	UP1	P1	V1/V0	US2	UFS2	UP2	P2	V2/V0
2.794	6.41	0.0304	5.44	0.99526					
-	6.46	0.0289	5.22	0.99553	5.801	0.609	0.311	50.9	0.94704
-	-	-	-	-	5.771	0.591	0.302	49.3	0.94836
-	-	-	-	-	5.745	0.572	0.293	47.5	0.94981
-	-	-	-	-	5.723	0.542	0.2775	45.0	0.95225
-	-	-	-	-	5.704	0.520	0.266	43.1	0.95405
-	-	-	-	-	5.685	0.496	0.254	41.1	0.95603
-	-	-	-	-	5.669	0.472	0.242	39.1	0.95804
-	-	-	-	-	5.658	0.447	0.2295	37.1	0.96018
-	-	-	-	-	5.647	0.421	0.2165	34.9	0.96242
-	6.40	0.0307	5.49	0.99520	5.721	0.535	0.274	44.5	0.95275
-	-	-	-	-	5.702	0.515	0.264	42.8	0.95428
-	-	-	-	-	5.683	0.493	0.253	40.9	0.95609
-	-	-	-	-	5.664	0.471	0.242	39.1	0.95791
-	-	-	-	-	5.643	0.449	0.231	37.2	0.95973
-	-	-	-	-	5.624	0.426	0.219	35.4	0.96157
-	-	-	-	-	5.603	0.403	0.208	33.4	0.96359
-	-	-	-	-	5.582	0.379	0.1955	31.4	0.96563
-	-	-	-	-	5.559	0.354	0.183	29.5	0.96767
-	-	-	-	-	5.535	0.329	0.170	27.4	0.96991
-	-	-	-	-	5.510	0.302	0.157	25.3	0.97216
-									
-	6.42	0.0040	0.70	0.9994	5.671	0.573	0.287	45.5	0.94967
-	-	-	-	-	5.639	0.530	0.266	41.9	0.95312
-	-	-	-	-	5.617	0.502	0.252	39.6	0.95544
-	-	-	-	-	5.597	0.474	0.238	37.2	0.95778
2.794	-	-	-	-	5.558	0.444	0.223	34.6	0.96020
-	-	-	-	-	5.543	0.414	0.208	32.2	0.96280
-	6.41	0.0038	0.7	0.9994					
-	6.39	0.0072	1.30	0.9989	5.676	0.559	0.282	44.8	0.95061

ALUMINUM 2024-T4

RHOO	US1	UP1	P1	V1/V0	US2	UFS2	UP2	P2	V2/V0
-	-	-	-	-	5.659	0.546	0.276	43.7	0.95161
-	-	-	-	-	5.642	0.530	0.268	42.3	0.95289
-	-	-	-	-	5.626	0.513	0.259	40.8	0.95427
-	-	-	-	-	5.611	0.495	0.250	39.3	0.95576
-	-	-	-	-	5.595	0.480	0.243	38.0	0.95697
-	-	-	-	-	5.581	0.462	0.234	36.5	0.95849
-	-	-	-	-	5.567	0.443	0.224	.35.0	0.96010
-	-	-	-	-	5.552	0.426	0.216	33.6	0.96152

US = 5.24 + 1.77*UP KM/SEC FOR FIRST 20 POINTS WITH
SIG US = 0.009 KM/SEC UP = 0.15 TO 0.3 KM/SEC.
US = 5.19 + 1.68*P KM/SEC FOR THE FOLLOWING 6 POINTS
SIG US = 0.005 KM/SEC WITH UP = 0.2 TO 0.3 KM/SEC
US = 5.15 + 1.83*UP KM/SEC FOR THE LAST 9 POINTS WITH
SIG US = 0.003 KM/SEC UP = 0.2 TO 0.58 KM/SEC.

COMMENTS:

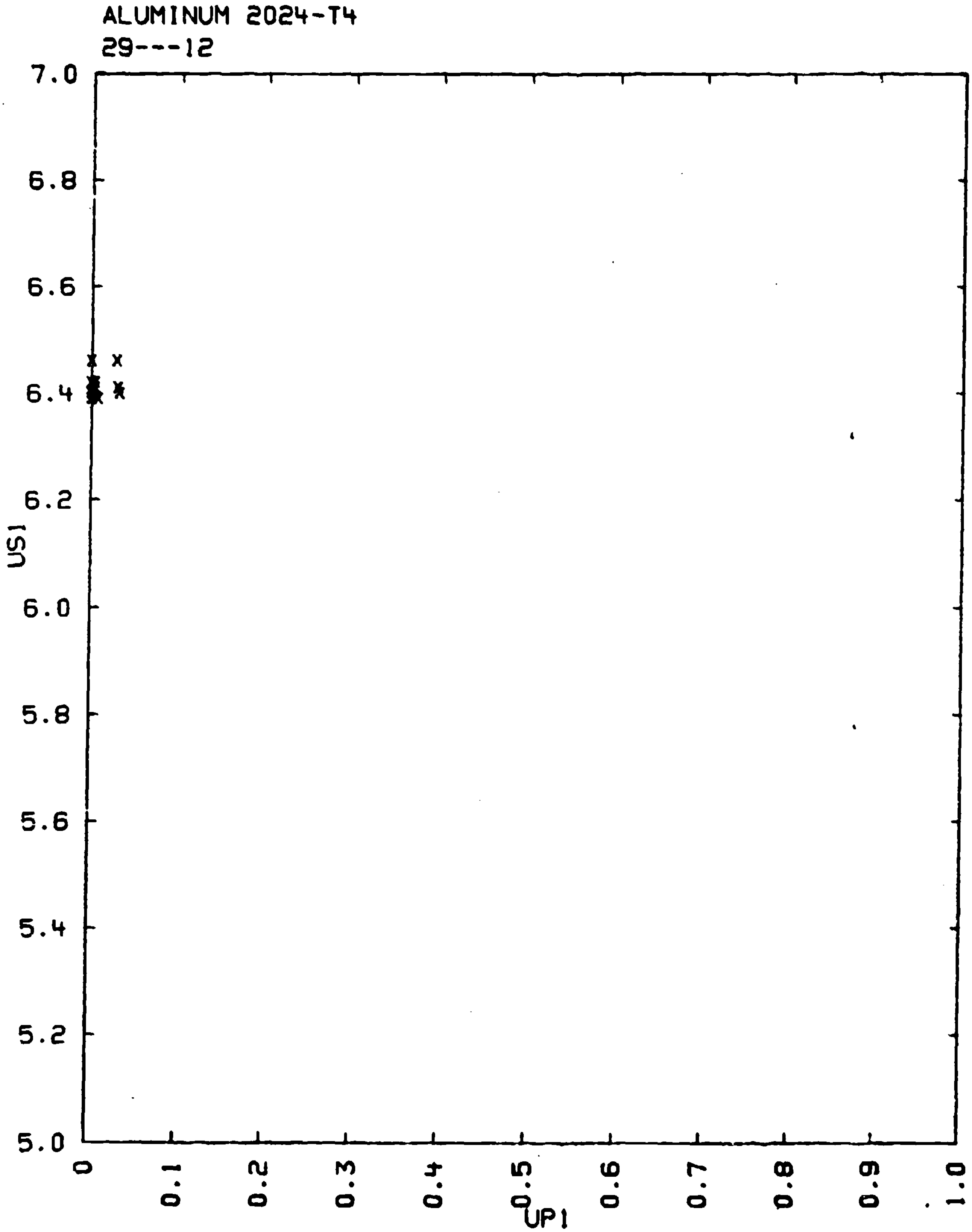
1) SOURCE: FOWLES G. R.
J. APPL. PHYS. VOL. 32, P. 1475 (1961)
2) EXPERIMENTAL METHOD D
DATA REDUCTION TECHNIQUE D:
THE ASSUMPTION UP1 = 1/2 UFS1 WAS USED
ARGUMENTS BASED ON ELASTIC THEORY YIELD 2UP = UFS + US(P1/K) -UP1 WHERE K IS THE BULK MODULUS AND P1/K IS THE SUM OF (V1/V0)-1 AND (VFINAL/V0)-1, WITH V1 THE VOLUME AT THE YIELD POINT, AND VFINAL THE VOLUME AFTER THE RELEASE WAVE FROM THE FREE SURFACE REDUCED THE PRESSURE TO ZERO.
3) THE ABOVE TABLE WAS OBTAINED FROM 6 SEPARATE EXPERIMENTS USING WEDGE SHAPED SAMPLES WITH A PRESSURE GRADIENT ACROSS ITS FACE. SOME CORRECTIONS WERE MADE FOR LACK OF NORMAL INCIDENCE OF THE WAVES.
4) OTHER CONSTANTS LISTED: YOUNGS MODULUS E = 760 KBAR
BULK - K = 728 -
RIGIDITY - G = 286.6 -
HEAT CAPACITY CV = 0.925 JOULES/(G.DEG.C)
GRUNEISEN RATIO GAMMA = 2.13
(DP/DT)V = 0.055 KBAR/DEG.C
5) THE FOLLOWING TENSILE YIELD POINTS WERE MEASURED:
HARDENED SAMPLE : 2.40 TO 2.90 KBAR
ANNEALED - : 0.70 TO 1.0 -
THE LARGER VALUE CORRESPONDS TO 2 PERCENT DEVIATION FROM THE LINEAR STRESS STRAIN CURVE.
6) A CORRELATION BETWEEN THE HUGONIOT ELASTIC LIMIT, ROCKWELL HARDNESS AND DISTANCE OF SHOCK TRAVEL IS GIVEN BY THE FOLLOWING TABLE:

P1	RH	X
3.4	B0	7.9
2.0	B0	15.9
12.6	B85	3.3
10.7	B85	7.9
7.9	B85	15.9

SEE : STRESS RELAXATION IN THE SHOCK COMPRESSION OF SOLIDS

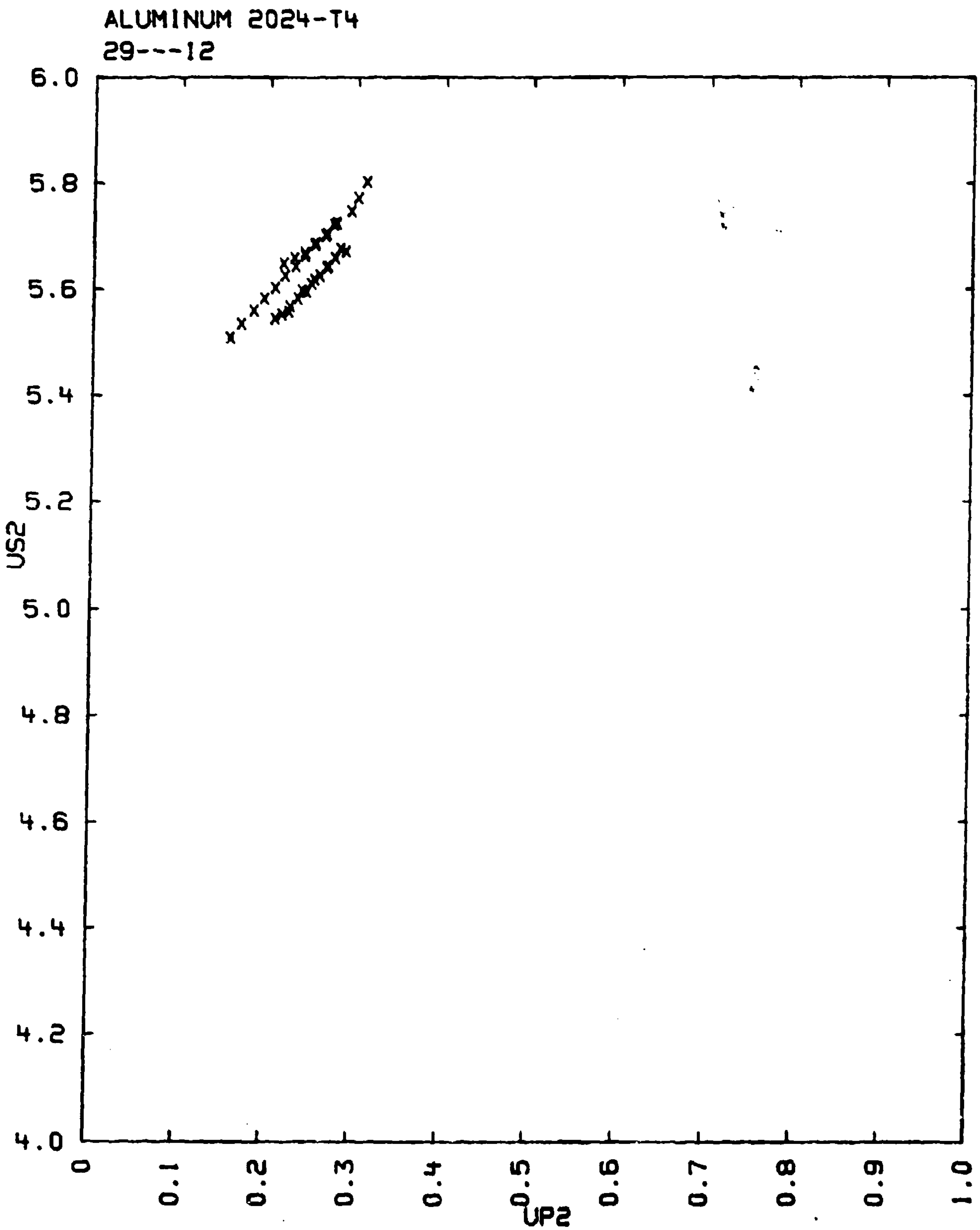
G. D. ANDERSON AND W. J. MURRI, TECHN. RPT. NO. AFL-TR-67-24
STANFORD RES. INST., 333 RAVENSWOOD AVE., MENLO PARK, CALIF.

TABLE I



ALUMINUM 2024-T4
29---12
7.0
6.8
6.6
6.4
6.2
6.0
5.8
5.6
5.4
5.2
5.0
US1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP1

TABLE I


ALUMINUM 2024-T4
29---12
US2
UP2
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

29---13
ALUMINUM 1060 ALLOY

FE		0.23	WEIGHT PERCENT	
CU SI MN MG	LESS THAN	0.08	-	-
AL	REMAINDER		-	-

V0 = 0.3695 CC/G   C0 = 5.240 KM/SEC
V0I= 0.3706 CC/G

THE TABLE LISTS ALL THE PRESSURES AND COMPRESSIONS OF THE MULTIPLE WAVE SYSTEMS USED IN THE DATA ANALYSIS OF THESE RELATIVELY BROAD SHOCK WAVES, TOGETHER WITH THE HYDROSTATIC PRESSURE (PH) AND THE APPROXIMATE USI AND UPI VALUES CALCULATED FROM THEM. DENSITY IS IN G/CC, VELOCITIES IN KM/SEC AND PRESSURE OR STRESS IN KBARS. NO = EXPERIMENT NUMBER. I INDICATES THE 1ST, 2ND, 3RD ETC. WAVE OF THE SYSTEM. U = PROJECTILE VELOCITY AND MAT IS THE PROJECTILE MATERIAL.

TABLE

U	RHO0	USI	UPI	PI	VI/V0	I	PH	MAT
.0086	2.706	6.7	0.0018	0.33	0.99973	1		AL
		5.4	0.0032	0.53	0.99948	2		
		5.1	0.0039	0.63	0.99934	3		
		3.8	0.0041	0.65	0.99929	4		
			0.0042	0.66	0.99928	5	0.53	
.0321	-	6.4	0.0017	0.30	0.99973	1		-
		6.1	0.0028	0.47	0.99956	2		
		5.7	0.0054	0.88	0.99909	3		
		5.5	0.0075	1.19	0.99871	4		
		5.3	0.0106	1.64	0.99812	5		
		5.2	0.0137	2.07	0.99753	6		
		5.0	0.0148	2.22	0.99731	7		
		4.6	0.0154	2.29	0.99719	8		
		4.7	0.0158	2.35	0.99709	9	2.17	
.0358	-	6.4	0.0021	0.37	0.99967	1		-
		5.9	0.0032	0.55	0.99948	2		
		5.7	0.0051	0.83	0.99916	3		
		5.5	0.0084	1.33	0.99854	4		
		5.3	0.0129	1.97	0.99770	5		
		5.1	0.0161	2.42	0.99707	6		
		4.4	0.0176	2.59	0.99675	7		
		4.3	0.0177	2.61	0.99671	8	2.44	
.0628	-	6.0	0.0024	0.39	0.9996	1		-
		5.4	0.0181	2.70	0.9967	2		
		5.2	0.0311	4.53	0.9942	3	4.34	
.0928	-	6.7	0.0020	0.36	0.9997	1		-
		5.4	0.0252	3.78	0.9954	2		
		5.2	0.0450	6.55	0.9916	3	6.35	

ALUMINUM 1060 ALLOY

U	RHOO	USI	UPI	PI	VI/VO	I	PH	MAT
.1620	-	6.0	0.0024	0.39	0.9996	1		-
		5.6	0.0317	4.79	0.9943	2		
		5.9	0.0740	11.52	0.9871	3		
		1.8	0.0770	11.66	0.9854	4	11.43	
.2197	-	6.4	0.0025	0.44	0.9996	1		-
		5.6	0.0359	5.46	0.9936	2		
		5.5	0.106	15.84	0.9807	3	15.59	
.3020	-	6.45	0.0026	0.45	0.9996	1		-
		5.70	0.148	22.36	0.9734	2	22.05	
.3995	-	6.13	0.0037	0.61	0.9994	1		-
		5.82	0.197	30.04	0.9650	2	29.68	
.4815	-	5.97	0.0065	1.06	0.9989	1		-
		5.91	0.237	36.42	0.9584	2	36.09	
.5210	-	6.44	0.0032	0.56	0.9995	1		-
		5.92	0.256	39.35	0.9549	2	38.99	

US = COMMENT 3

COMMENTS

1) SOURCE: MUNSON, D. E. AND BARKER, L. M.
J. APPL. PHYS., VOL. 37, P. 1652, (1966)
SANDIA CORPORATION, ALBUQUERQUE, NEW MEXICO.

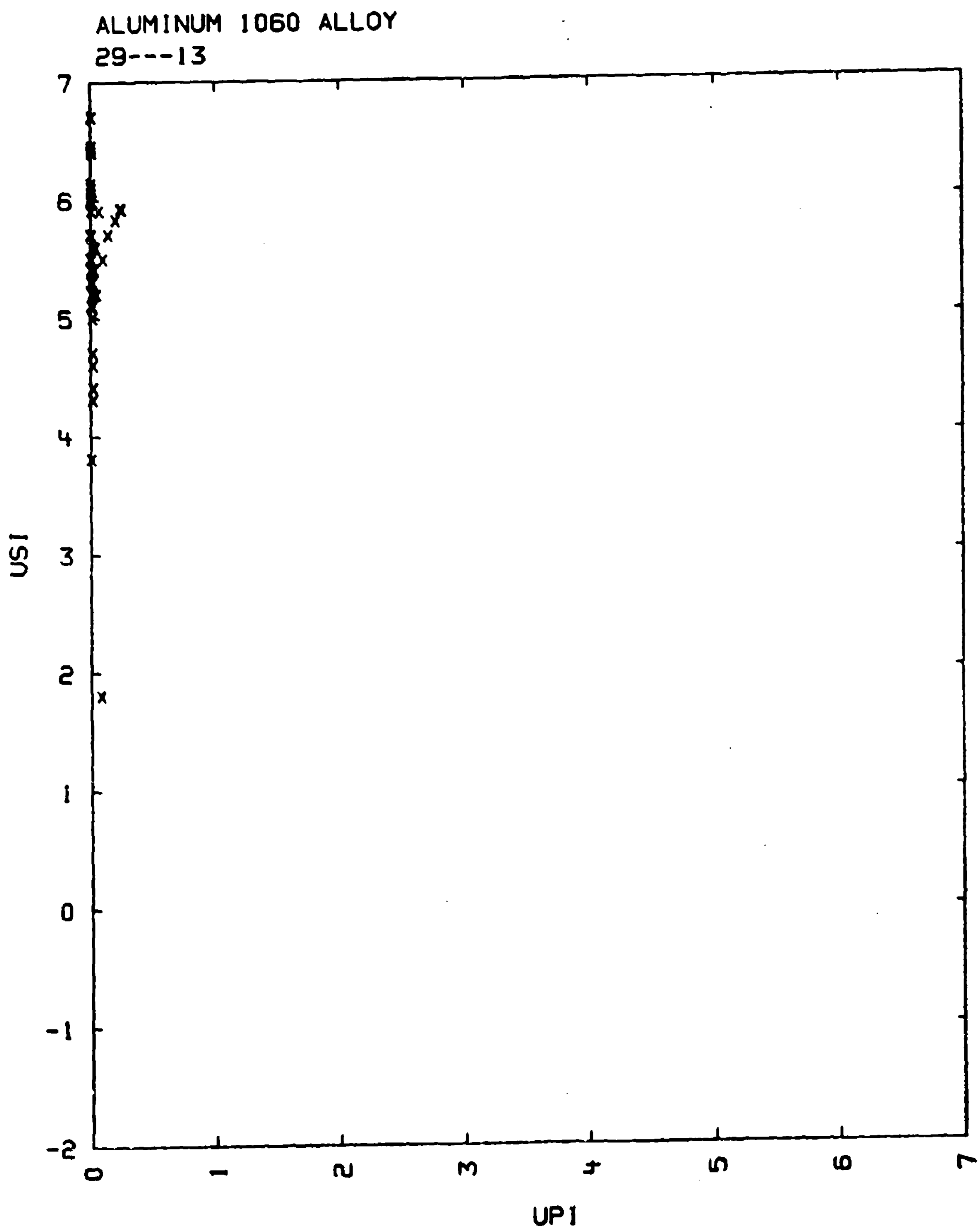
2) EXPERIMENTAL TECHNIQUE F AND AN INTERFEROMETRIC METHOD
DATA REDUCTION METHOD D WITH 2UP = UFS
WITH THE MODIFICATION THAT A SMOOTH BROAD WAVE IS APPROXIMATED BY A SET OF DISCREET PRESSURE STEPS. THE SHOCK VELOCITY MEASUREMENTS WERE CORRECTED FOR ERRORS INTRODUCED BY SURFACE INTERACTIONS.

3) NOTE THAT USI AND UPI ARE ONLY APPROXIMATE NUMBERS CALCULATED FROM THE PI AND VI/VO VALUES TO ILLUSTRATE THE WAVE THICKNESS. IN THE FIT BELOW US IS OBTAINED FROM THE MAXIMUM VALUE OF PH OF THE PARTICULAR WAVE SYSTEM AND THE CORRESPONDING VALUE OF VI, USING THE EQUALITY US = VO(PH/(VO-VI))**1/2, WHILE UP WAS TAKEN TO BE 1/2 THE MAXIMUM FREE SURFACE VELOCITY. THESE POINTS ARE COMBINED WITH DATA FROM LOS-ALAMOS SCIENTIFIC LABORATORY TO GIVE:
US = 5.270 + 1.429*UP - 0.0119*UP**2 KM/SEC, TO UP = 4.45 KM/SEC
MAX. DEVIATION 1.0 PERCENT.

4) PH = PI - 2/3*Y, WHERE THE YIELD POINT Y IS A FUNCTION OF THE DEGREE OF WORK HARDENING.

5) VOI WAS CALCULATED FROM THE CUBIC UNIT CELL CONSTANT GIVEN IN WYCKOFF, CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, 1963)
A = 4.04958 ANGSTROM AT 25 DEG. CENTIGRATE.

TABLE I



29---14
ALUMINUM 2024

CU	3.8-4.9	WT. PERCENT
MG	1.2-1.8	- -
MN	0.3-0.9	- -
SI	0.5	- -
FE	0.5	- -
ZN	0.25	- -
CR	0.10	- -
AL	REST	- -

V0 = 0.3593 CC/G   CL = 6.38 KM/SEC   C0 = 5.20 KM/SEC
CS = 3.20 KM/SEC

THE TABLE LISTS RHOO IN G/CC, VELOCITIES IN KM/SEC AND P IN KBARS. CU= COPPER, FS= FANSTEEL, AL= ALUMINUM AND WF= WEIGHTING FACTOR.

TABLE

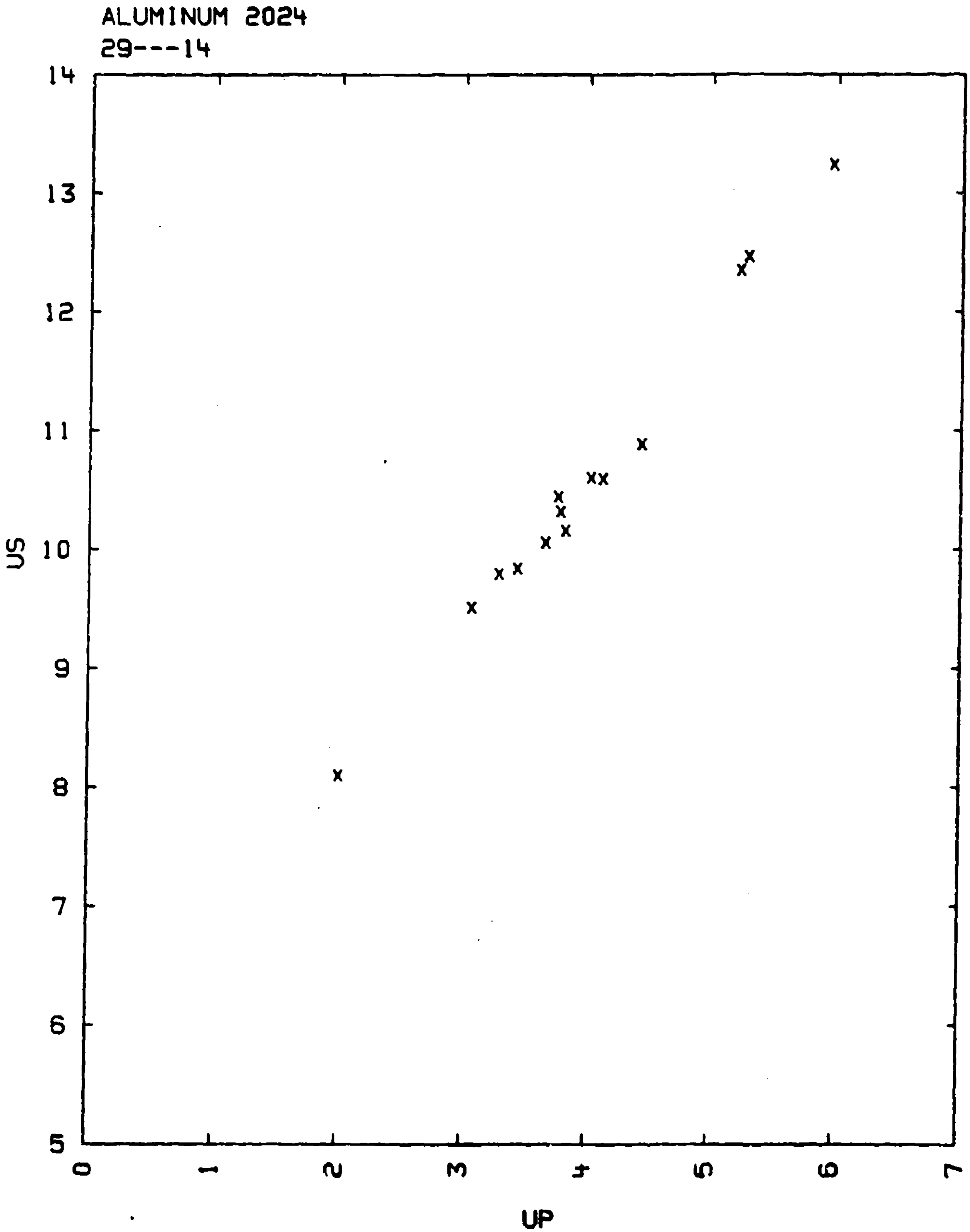
SAMPLE					IMPACTOR		
RHOO	US	UP	P	V/VO	MAT	U	WF
2.783	8.099	2.017	455.	.7510	FS	2.583	1
2.783	9.504	3.081	815.	.6758	AL	6.161	1
2.783	9.793	3.289	896.	.6642	CU	4.883	1
2.783	9.839	3.439	942.	.6505	AL	6.876	1
2.783	10.047	3.663	1024.	.6354	FS	4.775	1
2.783	10.432	3.763	1092.	.6393	AL	7.526	1
2.783	10.313	3.789	1088.	.6326	CU	5.621	1
2.783	10.159	3.828	1082.	.6232	CU	5.654	1
2.783	10.594	4.034	1189.	.6192	AL	8.067	1
2.783	10.585	4.127	1216.	.6101	FS	5.400	1
2.783	10.884	4.438	1344.	.5922	CU	6.567	1
2.783	12.351	5.237	1800.	.5760	CU	7.833	1
2.783	12.460	5.297	1837.	.5749	CU	7.929	1
2.783	13.228	5.962	2196.	.5491	FS	7.947	1

US = 5.471 + 1.310*UP KM/SEC
SIG.US = 0.022 KM/SEC

COMMENTS:

1) SOURCE: ISBELL H.M., SHIPMAN F.H. AND JONES A.H.
HUGONIOT EQUATION OF STATE OF ELEVEN MATERIALS TO FIVE MBARS
MATERIALS SCIENCE LABORATORY REPORT: MSL-68-13
2) EXPERIMENTAL TECHNIQUE: A
DATA REDUCTION METHOD : A
3) NOMINAL UNCERTAINTIES ARE: (SIG.US)/US = .005 AND (SIG.U)/U = .0005
4) POISSONS RATIO = 0.332 ; YIELD STRENGTH = 3.2 KBAR
ULTIMATE TENSILE STRENGTH = 4.7 KBAR
ULTIMATE TENSILE STRENGTH = 4.7 KBAR

TABLE I



29---15
2024 ALUMINUM

AL	93.
CU	3.8 - 4.9
MG	1.2 - 1.8
MN	0.3 - 0.9
FE	0.5
SI	0.5
ZN	0.25
CR	0.1

V0 = 0.3585-0.3591 CC/G   CL = 6.39 KM/SEC   C0 = 5.25 KM/SEC
CS = 3.15 KM/SEC

IN THE TABLES BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBAR AND DENSITY IN G/CC. THE IMPACTOR IS THE STANDARD.

TABLE 1

----------------SAMPLE				--------------------	-----STANDARD-----
RHOO	US	UP	P	V/VO	MATERIAL
2.785	6.02	0.50	84.	0.9169	2024 AL
2.785	6.10	0.50	85.	0.9180	2024 AL
2.785	6.05	0.51	86.	0.9157	2024 AL
2.782	6.16	0.67	115.	0.8912	2024 AL
2.785	6.35	0.77	136.	0.8787	2024 AL
2.782	6.49	0.86	155.	0.8675	2024 AL
2.785	6.52	0.87	158.	0.8666	2024 AL
2.782	6.61	0.97	178.	0.8533	2024 AL
2.789	6.86	1.15	220.	0.8324	2024 AL
2.789	6.89	1.16	223.	0.8316	2024 AL
2.780	6.91	1.16	223.	0.8321	2024 AL
2.789	6.86	1.21	232.	0.8236	2024 AL
2.789	7.27	1.43	290.	0.8033	2024 AL
2.789	7.33	1.58	323.	0.7844	2024 AL
2.779	7.51	1.62	338.	0.7843	2024 AL
2.789	7.69	1.72	368.	0.7760	2024 AL
2.789	7.66	1.77	378.	0.7689	2024 AL
2.789	7.80	1.73	367.	0.7724	2024 AL
2.789	7.77	1.81	392.	0.7671	2024 AL
2.789	7.69	1.85	397.	0.7594	2024 AL
2.779	7.97	1.95	432.	0.7553	2024 AL
2.789	8.13	2.13	483.	0.7380	2024 AL
2.789	8.33	2.16	502.	0.7407	2024 AL
2.789	8.23	2.21	507.	0.7315	2024 AL
2.779	8.40	2.31	539.	0.7250	2024 AL
2.789	8.53	2.45	583.	0.7128	2024 AL
2.789	8.83	2.59	638.	0.7067	2024 AL
2.789	8.76	2.60	635.	0.7032	2024 AL
2.789	8.80	2.65	650.	0.6989	2024 AL
2.789	9.14	2.82	719.	0.6915	2024 AL
2.789	9.40	2.99	784.	0.6819	2024 AL

2024 ALUMINUM

RHOO	US	UP	P	V/VO	MATERIAL
2.789	9.67	3.22	868.	0.6670	2024 AL
2.789	9.64	3.29	885.	0.6587	2024 AL
2.778	9.87	3.42	938.	0.6535	2024 AL
2.778	10.19	3.72	1053.	0.6349	2024 AL
2.789	10.37	3.75	1085.	0.6384	2024 AL

US = 5.328 + 1.338*UP KM/SEC HUGONIOT FIT ADOPTED BY THE SOURCE
COMPARISON LEAST SQUARE FITS:
US = A0 + A1*UP KM/SEC
A0 = 5.343 KM/SEC   SIG A0 = 0.022 KM/SEC
A1 = 1.325 -   SIG A1 = 0.010 -
SIG US = 0.058 -

TABLE II

----------------SAMPLE----------------					-----STANDARD-----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
2.784	6.00	0.50	84.	0.9167	921-T AL	5.76
2.783	5.95	0.51	84.	0.9143	921-T AL	5.77
2.784	5.95	0.51	84.	0.9143	921-T AL	5.77
2.785	6.12	0.61	104.	0.9003	921-T AL	5.91
2.785	6.10	0.61	104.	0.9000	921-T AL	5.91
2.785	6.53	0.91	165.	0.8606	921-T AL	6.34
2.785	6.53	0.91	165.	0.8606	921-T AL	6.34
2.784	6.56	0.98	179.	0.8506	921-T AL	6.43
2.784	6.51	0.99	179.	0.8479	921-T AL	6.44
2.780	6.49	0.99	179.	0.8475	921-T AL	6.44
2.785	6.95	1.26	244.	0.8187	921-T AL	6.83
2.777	6.94	1.26	243.	0.8184	291-T AL	6.83
2.784	6.94	1.28	247.	0.8156	921-T AL	6.86
2.781	7.61	1.73	366.	0.7727	921-T AL	7.49
2.781	7.61	1.73	366.	0.7727	921-T AL	7.49
2.784	7.62	1.74	369.	0.7717	921-T AL	7.52
2.783	8.70	2.47	598.	0.7161	921-T AL	8.54
2.783	8.62	2.48	595.	0.7123	921-T AL	8.54
2.781	9.60	3.18	849.	0.6687	921-T AL	9.53
2.781	9.55	3.19	847.	0.6660	921-T AL	9.53
2.779	9.62	3.27	874.	0.6601	921-T AL	9.65
2.781	9.92	3.40	938.	0.6573	921-T AL	9.84
2.781	9.87	3.41	936.	0.6545	921-T AL	9.84

US = A0 + A1*UP KM/SEC
A0 = 5.253 KM/SEC   SIG A0 = 0.020 KM/SEC
A1 = 1.357 -   SIG A1 = 0.010 -
SIG US = 0.050 -

TABLE III

---SAMPLE---					---STANDARD---	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
2.784	5.81	0.28	45.	0.9518	CU	4.24
2.784	5.78	0.28	45.	0.9516	CU	4.24
2.784	6.02	0.44	74.	0.9269	CU	4.41
2.782	6.05	0.47	79.	0.9223	CU	4.45
2.784	6.23	0.65	113.	0.8957	CU	4.64
2.782	6.28	0.68	119.	0.8917	CU	4.67
2.785	6.37	0.72	128.	0.8870	CU	4.72
2.784	6.32	0.73	128.	0.8845	CU	4.72
2.784	6.31	0.73	128.	0.8843	CU	4.72
2.783	6.39	0.78	139.	0.8779	CU	4.78
2.784	6.52	0.86	156.	0.8681	CU	4.87
2.782	6.59	0.89	163.	0.8649	CU	4.90
2.784	6.59	0.90	165.	0.8634	CU	4.91
2.784	6.58	0.90	165.	0.8632	CU	4.91
2.782	6.66	0.97	180.	0.8544	CU	4.98
2.782	7.06	1.32	259.	0.8130	CU	5.37
2.781	7.09	1.35	266.	0.8096	CU	5.40
2.782	7.22	1.38	277.	0.8089	CU	5.44
2.785	7.18	1.44	287.	0.7989	CU	5.49
2.782	7.21	1.45	291.	0.7989	CU	5.51
2.782	7.85	1.86	406.	0.7631	CU	5.97
2.782	8.11	2.09	472.	0.7423	CU	6.23
2.781	8.08	2.10	472.	0.7401	CU	6.22
2.782	8.36	2.33	542.	0.7213	CU	6.48
2.785	8.42	2.33	546.	0.7233	CU	6.49
2.784	8.44	2.37	557.	0.7192	CU	6.53
2.781	8.57	2.45	584.	0.7141	CU	6.62
2.782	8.75	2.60	633.	0.7029	CU	6.79
2.782	8.91	2.73	677.	0.6936	CU	6.93
2.782	8.92	2.74	680.	0.6928	CU	6.94
2.782	9.23	2.93	752.	0.6826	CU	7.16
2.782	9.77	3.35	911.	0.6571	CU	7.62
2.780	9.75	3.36	911.	0.6554	CU	7.63
2.780	9.80	3.38	921.	0.6551	CU	7.65
2.782	9.75	3.38	917.	0.6533	CU	7.65
2.782	9.82	3.39	926.	0.6548	CU	7.67
2.780	10.04	3.62	1010.	0.6394	CU	7.92
2.784	10.24	3.63	1035.	0.6455	CU	7.95

US = A0 + A1*UP KM/SEC

A0 = 5.398 KM/SEC   SIG A0 = 0.014 KM/SEC

A1 = 1.296 -   SIG A1 = 0.007 -

SIG US = 0.044 -

TABLE IV

---SAMPLE---					---STANDARD---	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
2.784	6.62	0.95	175.	0.8565	FE	4.93
2.784	6.62	0.95	175.	0.8565	FE	4.93
2.784	7.14	1.36	270.	0.8095	FE	5.49

2024 ALUMINUM

RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
2.784	7.14	1.36	270.	0.8095	FE	5.49
2.784	8.15	2.15	488.	0.7362	FE	6.53
2.784	8.15	2.15	488.	0.7362	FE	6.53
2.784	8.85	2.64	650.	0.7017	FE	7.15
2.784	8.80	2.64	1627.	0.2455	FE	7.15
2.784	9.76	3.24	880.	0.6680	FE	7.90
2.784	9.43	3.27	858.	0.6532	FE	7.90
2.784	9.76	3.29	894.	0.6629	FE	7.98
2.784	9.72	3.30	893.	0.6605	FE	7.98
2.784	9.67	3.38	910.	0.6505	FE	8.05
2.784	9.61	3.39	907.	0.6472	FE	8.05
2.784	10.46	3.77	1098.	0.6396	FE	8.54
2.784	10.41	3.78	1095.	0.6369	FE	8.54
2.784	10.43	3.78	1098.	0.6376	FE	8.54
2.784	10.34	3.79	1091.	0.6335	FE	8.54

US = A0 + A1*UP KM/SEC
A0 = 5.333 KM/SEC SIG A0 = 0.074 KM/SEC
A1 = 1.323 - SIG A1 = 0.025 -
SIG US = 0.106 -

TABLE V

---SAMPLE---					---STANDARD---	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
2.782	6.26	0.63	110.	0.8994	TU-3 MO	3.20
2.782	6.23	0.63	109.	0.8989	TU-3 MO	3.20
2.784	6.36	0.79	140.	0.8758	TU-3 73	3.37
2.782	6.46	0.80	144.	0.8762	TU-3 MO	3.38
2.782	6.39	0.80	142.	0.8748	TU-3 MO	3.38
2.782	6.82	1.08	205.	0.8416	TU-3 MO	3.66
2.784	6.84	1.12	213.	0.8363	TU-3 MO	3.70
2.784	7.01	1.22	238.	0.8260	TU-3 MO	3.81
2.784	6.98	1.22	237.	0.8252	TU-3 MO	3.81
2.785	7.69	1.74	373.	0.7737	TU-3 MO	4.34
2.784	7.76	1.78	385.	0.7706	TU-3 MO	4.38
2.785	7.77	1.94	420.	0.7503	TU-3 MO	4.53
2.782	8.05	1.95	437.	0.7578	TU-3 MO	4.56
2.782	8.01	1.96	437.	0.7553	TU-3 MO	4.58
2.784	9.24	2.97	764.	0.6786	TU-3 MO	5.59
2.784	10.39	3.71	1073.	0.6429	TU-3 MO	6.35
2.789	10.14	3.73	1055.	0.6321	TU-3 MO	6.35

US = A0 + A1*UP KM/SEC
A0 = 5.393 KM/SEC SIG A0 = 0.038 KM/SEC
A1 = 1.308 - SIG A1 = 0.020 -
SIG US = 0.078 -

TABLE VI

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
2.571	4.78	0.72	88.	0.8494	2024 AL	6.17
2.647	5.36	1.00	142.	0.8134	2024 AL	6.53
2.524	5.16	1.03	134.	0.8004	2024 AL	6.52
2.575	5.98	1.33	205.	0.7776	2024 AL	6.94
2.566	6.85	1.76	309.	0.7431	2024 AL	7.52
2.532	6.00	1.92	292.	0.6800	2024 AL	7.58
2.472	6.93	1.99	341.	0.7128	2024 AL	7.75
2.554	7.55	2.23	430.	0.7046	2024 AL	8.12
2.465	7.91	2.58	503.	0.6738	2024 AL	8.52
2.554	8.32	2.70	574.	0.6755	2024 AL	8.74
2.605	8.37	2.79	608.	0.6667	2024 AL	8.87
2.583	8.81	3.03	690.	0.6561	2024 AL	9.19
2.506	8.72	3.05	666.	0.6502	2024 AL	9.17
2.603	9.09	3.23	764.	0.6447	2024 AL	9.47
2.535	9.15	3.30	765.	0.6393	2024 AL	9.52
2.585	9.59	3.55	880.	0.6298	2024 AL	9.89
2.543	9.58	3.59	875.	0.6253	2024 AL	9.90
2.522	9.54	3.62	871.	0.6205	2024 AL	9.92
2.510	9.63	3.64	880.	0.6220	2024 AL	9.95
2.631	9.84	3.73	966.	0.6209	2024 AL	10.15
2.618	9.84	3.80	979.	0.6138	2024 AL	10.22
2.617	9.90	3.82	990.	0.6141	2024 AL	10.25

US =

TABLE VII

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
2.241	3.47	0.85	66.	0.7550	2024 AL	6.17
2.261	4.30	1.14	111.	0.7349	2024 AL	6.52
2.183	4.10	1.18	106.	0.7122	2024 AL	6.53
2.062	4.89	1.55	156.	0.6830	2024 AL	6.94
2.271	6.12	1.93	268.	0.6846	2024 AL	7.52
2.136	6.54	1.98	277.	0.6972	2024 AL	7.58
2.247	6.40	2.12	305.	0.6687	2024 AL	7.75
2.193	6.90	2.44	369.	0.6464	2024 AL	8.12
2.260	7.63	2.70	466.	0.6461	2024 AL	8.52
2.266	7.91	2.88	516.	0.6359	2024 AL	8.74
2.186	7.88	3.04	524.	0.6142	2024 AL	8.87
2.301	8.47	3.21	626.	0.6210	2024 AL	9.19
2.203	8.30	3.26	596.	0.6072	2024 AL	9.17
2.280	8.53	3.48	677.	0.5920	2024 AL	9.47
2.198	8.80	3.53	683.	0.5989	2024 AL	9.52
2.287	9.27	3.77	799.	0.5933	2024 AL	9.89
2.208	9.27	3.83	784.	0.5868	2024 AL	9.90
2.217	9.26	3.84	788.	0.5853	2024 AL	9.92
2.229	9.28	3.86	798.	0.5841	2024 AL	9.95
2.211	9.64	4.01	855.	0.5840	2024 AL	10.15

2024 ALUMINUM

RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
2.265	9.65	4.04	883.	0.5813	2024 AL	10.22
2.289	9.57	4.06	889.	0.5758	2024 AL	10.25

US =

TABLE VIII

-----SAMPLE-----					-----STANDARD-----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
1.993	2.91	0.92	53.	0.6838	2024 AL	6.17
1.957	2.77	0.93	50.	0.6643	2024 AL	6.16
1.966	3.62	1.25	89.	0.6547	2024 AL	6.52
1.929	3.62	1.27	89.	0.6492	2024 AL	6.53
1.908	4.40	1.64	138.	0.6273	2024 AL	6.94
2.010	5.52	2.07	234.	0.6317	2024 AL	7.52
1.970	5.49	2.16	234.	0.6066	2024 AL	7.58
1.995	5.99	2.26	270.	0.6227	2024 AL	7.75
1.981	6.61	2.57	337.	0.6112	2024 AL	8.12
1.916	7.05	2.94	397.	0.5830	2024 AL	8.52
1.959	7.47	3.09	452.	0.5863	2024 AL	8.74
1.880	7.56	3.25	462.	0.5701	2024 AL	8.87
2.019	8.00	3.40	549.	0.5750	2024 AL	9.17
2.037	8.04	3.42	560.	0.5746	2024 AL	9.19
1.933	8.48	3.69	605.	0.5649	2024 AL	9.47
1.888	8.38	3.78	598.	0.5489	2024 AL	9.52
2.065	8.92	3.99	735.	0.5527	2024 AL	9.92
1.996	9.02	4.01	722.	0.5554	2024 AL	9.90
1.983	9.03	4.06	727.	0.5504	2024 AL	9.95
1.825	8.76	4.15	663.	0.5263	2024 AL	9.89
1.916	9.16	4.29	753.	0.5317	2024 AL	10.15
1.951	9.32	4.33	787.	0.5354	2024 AL	10.25
1.899	9.25	4.36	766.	0.5286	2024 AL	10.22

US =

TABLE IX

-----SAMPLE-----					-----STANDARD-----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
1.659	2.47	0.98	40.	0.6032	2024 AL	6.16
1.622	2.31	1.01	38.	0.5828	2024 AL	6.17
1.699	3.33	1.34	76.	0.5976	2024 AL	6.53
1.618	2.98	1.38	67.	0.5369	2024 AL	6.52
1.648	4.05	1.75	117.	0.5679	2024 AL	6.94
1.663	5.15	2.25	193.	0.5631	2024 AL	7.52
1.687	5.13	2.31	200.	0.5497	2024 AL	7.58
1.626	5.84	2.45	225.	0.5658	2024 AL	7.75

2024 ALUMINUM

RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
1.700	6.26	2.74	292.	0.5623	2024 AL	8.12
1.661	6.68	3.12	346.	0.5329	2024 AL	8.52
1.671	7.09	3.30	391.	0.5346	2024 AL	8.74
1.687	7.41	3.38	423.	0.5439	2024 AL	8.87
1.685	7.60	3.67	470.	0.5171	2024 AL	9.17
1.691	7.74	3.67	480.	0.5258	2024 AL	9.19
1.657	8.18	3.92	531.	0.5208	2024 AL	9.47
1.656	8.20	3.97	539.	0.5159	2024 AL	9.52
1.707	8.76	4.24	634.	0.5160	2024 AL	9.89
1.596	8.71	4.35	605.	0.5006	2024 AL	9.90
1.603	8.65	4.37	606.	0.4948	2024 AL	9.92
1.544	8.64	4.45	594.	0.4850	2024 AL	9.95
1.673	9.00	4.50	678.	0.5000	2024 AL	10.15
1.713	9.02	4.54	701.	0.4967	2024 AL	10.22
1.694	9.12	4.57	706.	0.4989	2024 AL	10.25

US =

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES. HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII
2) EXPERIMENTAL TECHNIQUE: 1 B
DATA REDUCTION TECHNIQUE: A (TABLE 1) B(THE REST)
3) TABLE 1 IS THE HUGONIOT OBTAINED WITH SYMMETRIC IMPACT. TABLE II THROUGH V CHECK THE INTERNAL CONSISTENCY OF THE SYMMETRIC IMPACT HUGONIOTS OF CU, FE U-MO ALLOY AND 921T AL.
4) THE GRUNEISEN GAMMA OF 2.00 (= GAM) WITH THE ASSUMPTION THAT RHOO.GAM = CONSTANT REPRESENTS THE BEHAVIOR OF THE POROUS SAMPLES. ALSO GIVEN ARE (DV/DT)/V=6.54 E-5 PER DEG. AND CP = 0.879 JOULES PER G. DEG.
5) HUGONIOT ELASTIC LIMIT 5.4 KBAR.
6) THE 921-T AL PLATE STOCK USED TO OBTAIN THE CROSS CHECK DATA IN TABLE II IS SLIGHTLY POROUS.

TABLE I

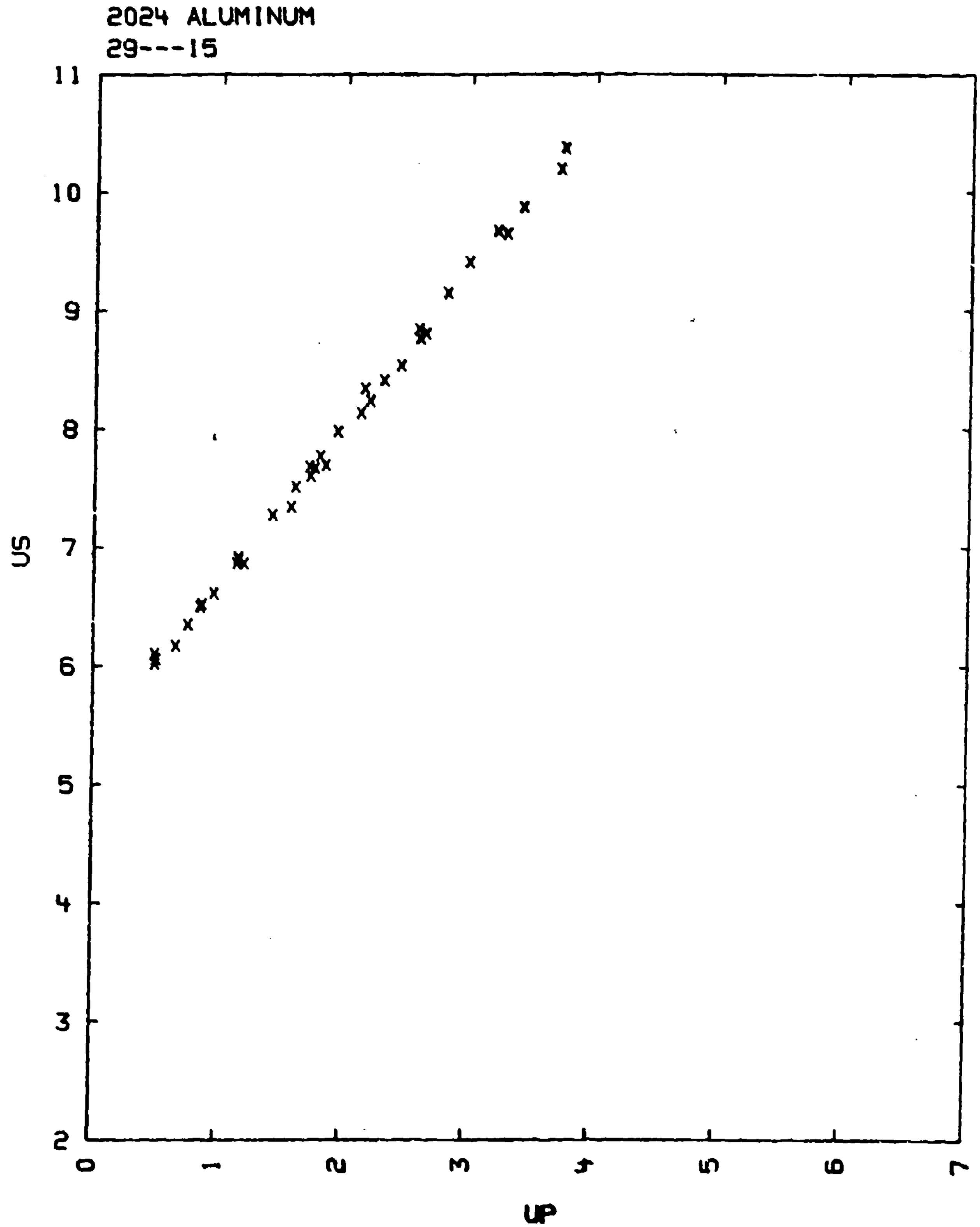


TABLE II

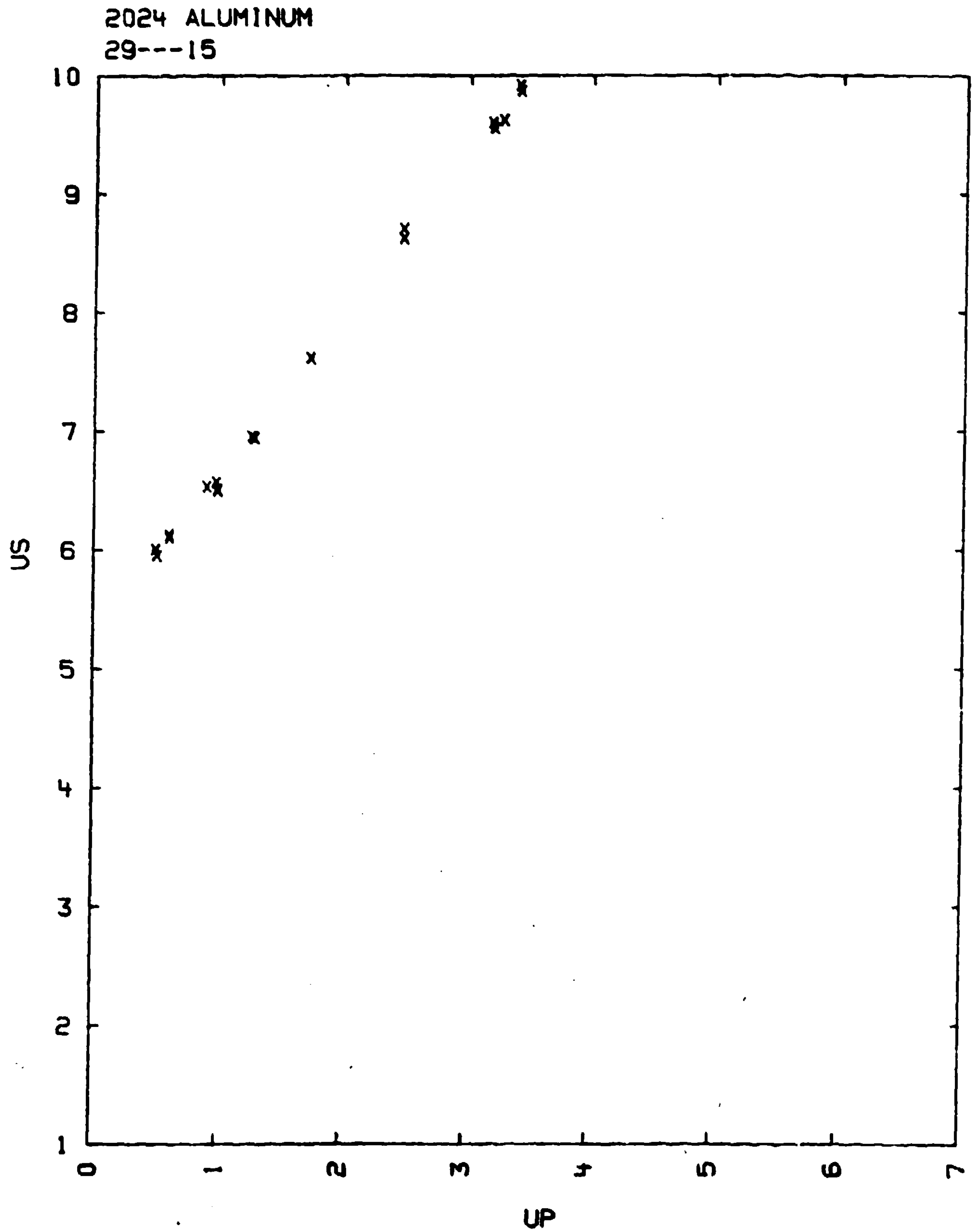


TABLE III

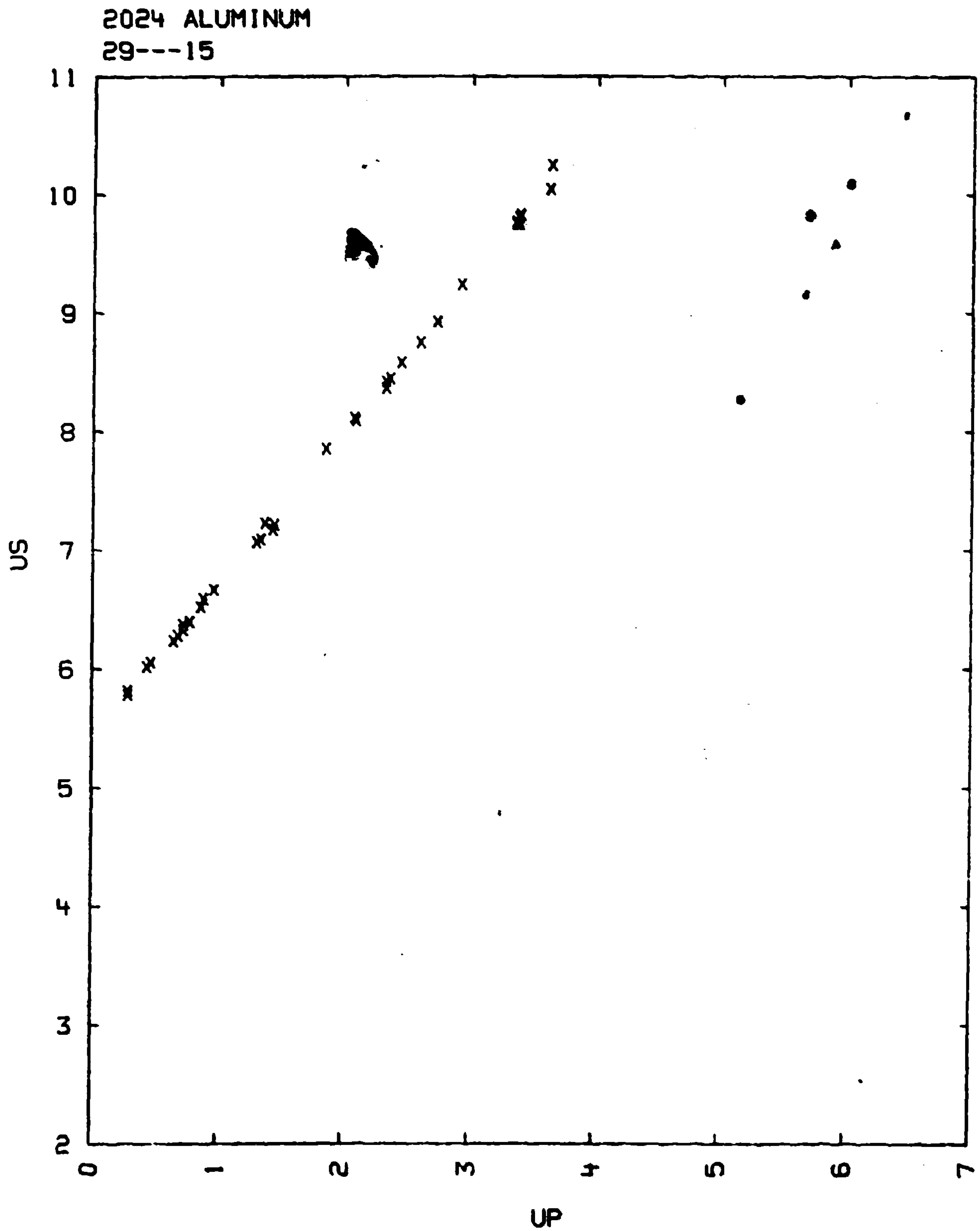


TABLE IV

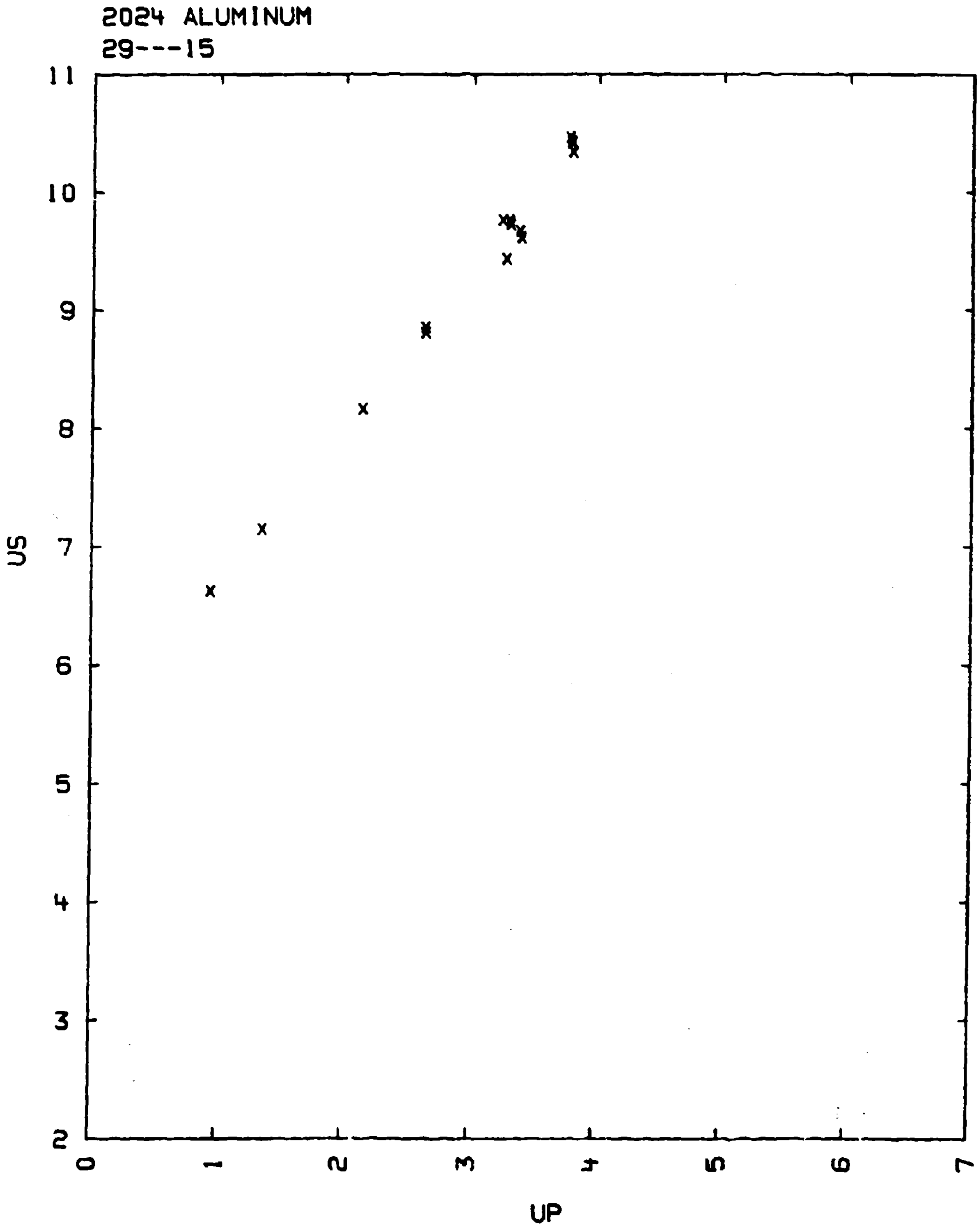


TABLE V

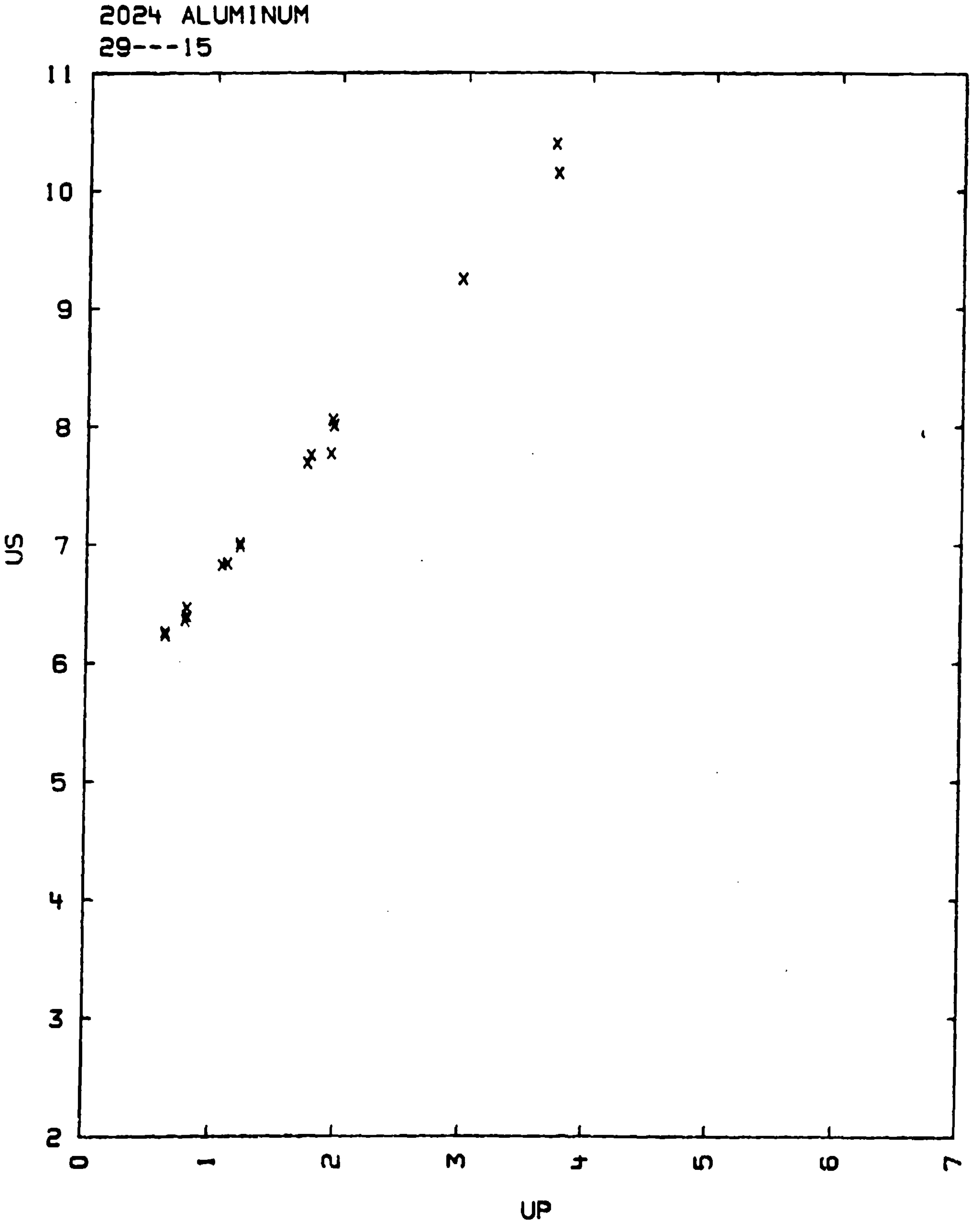


TABLE VI

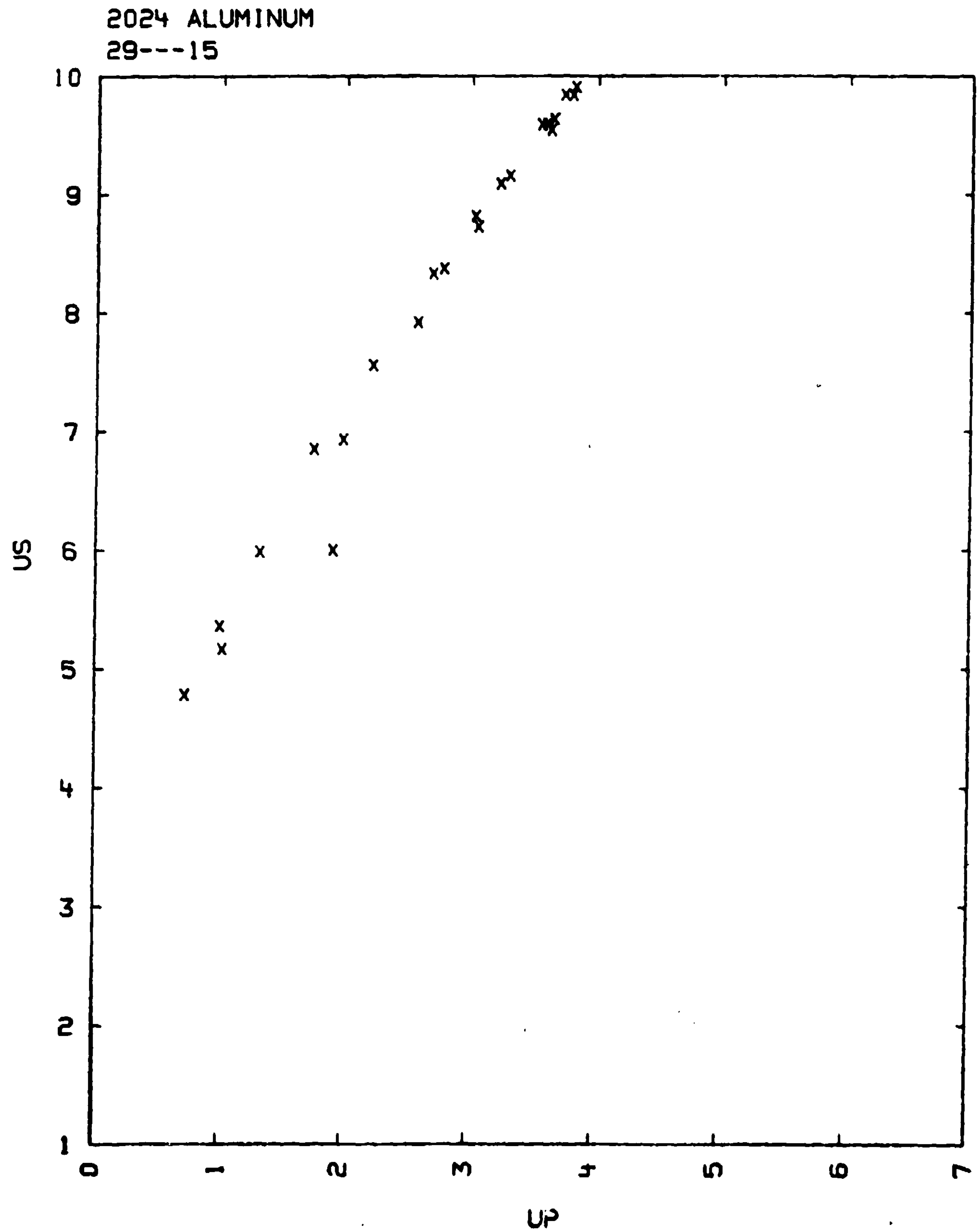


TABLE VII

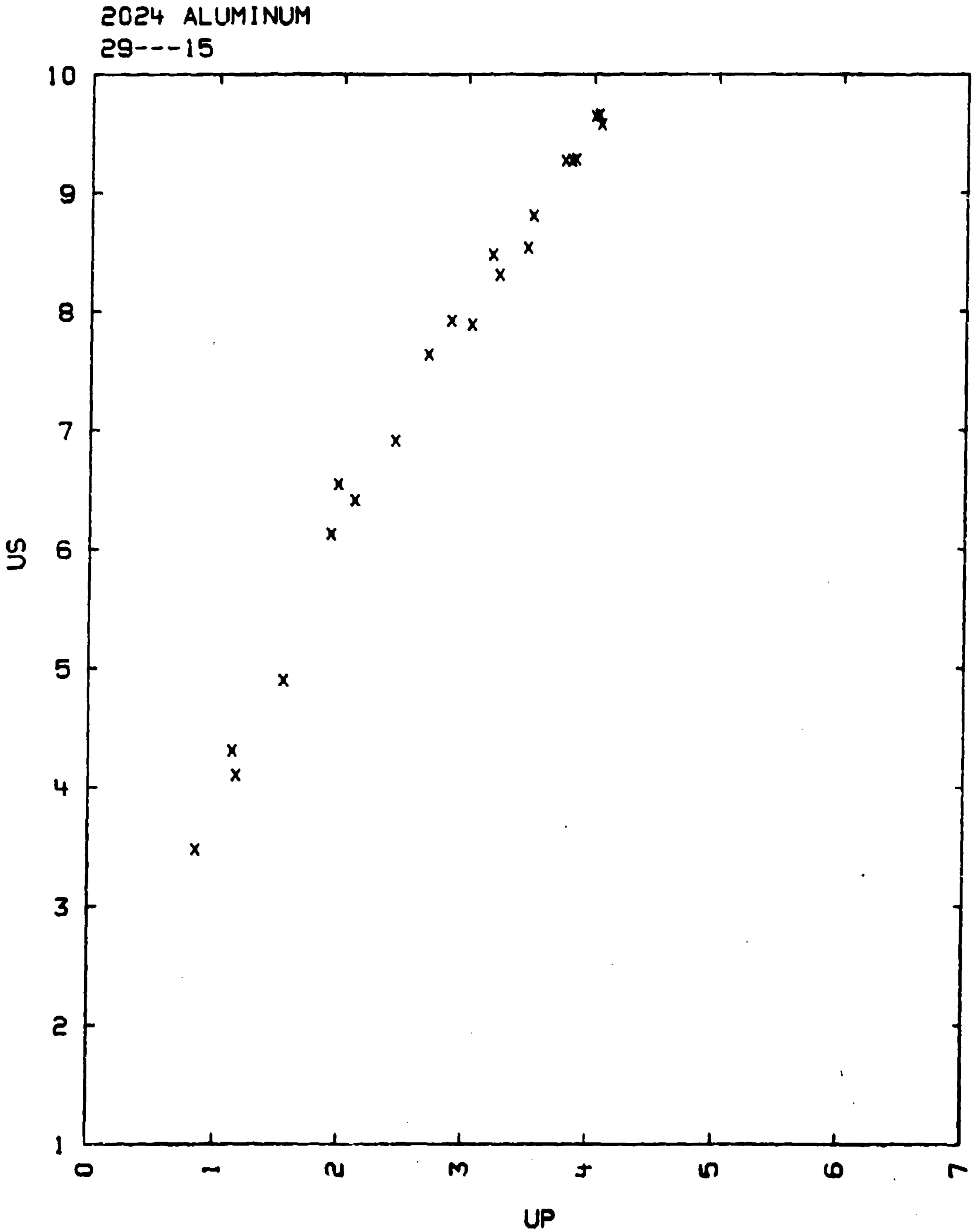


TABLE VIII

2024 ALUMINUM
29---15

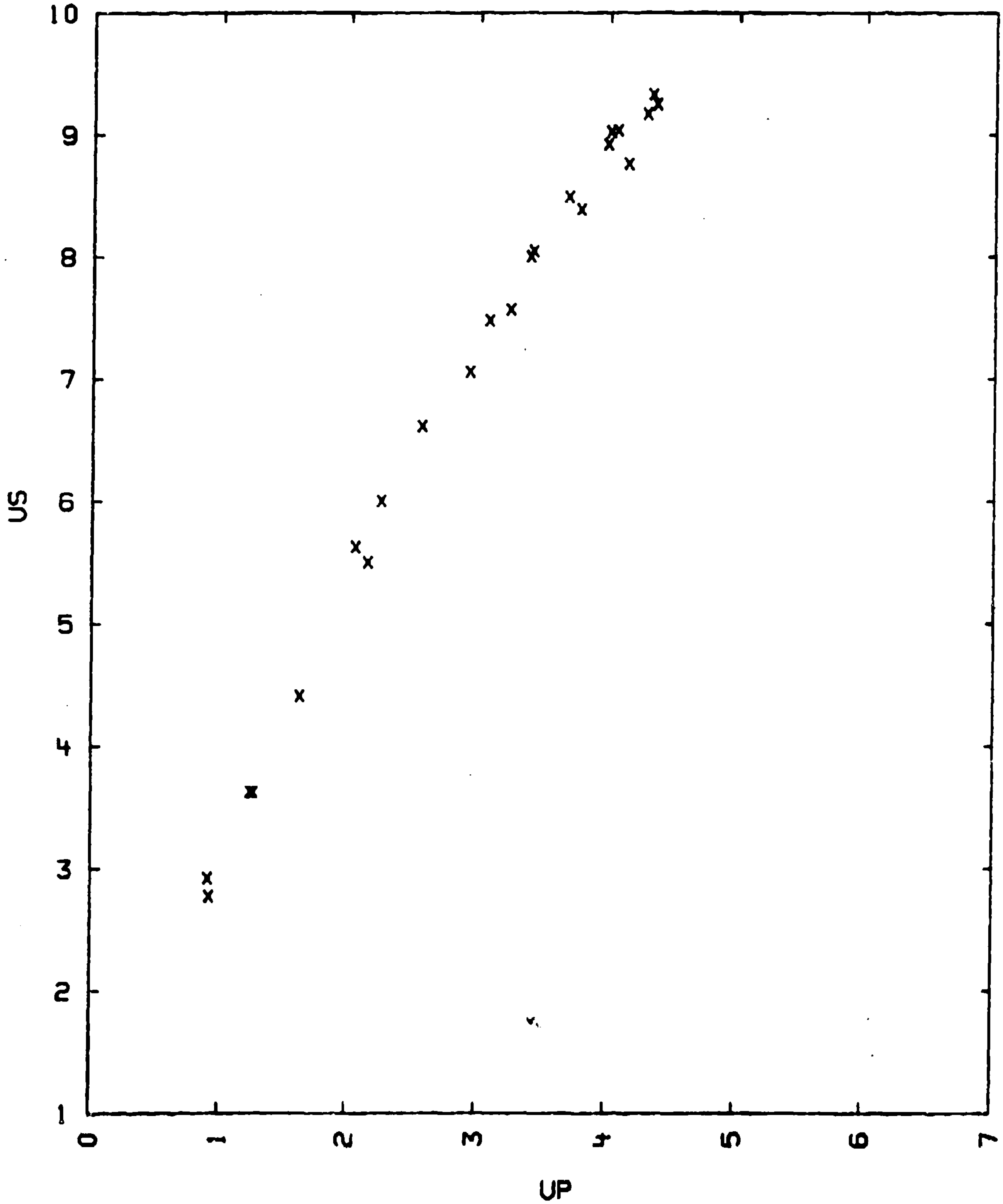
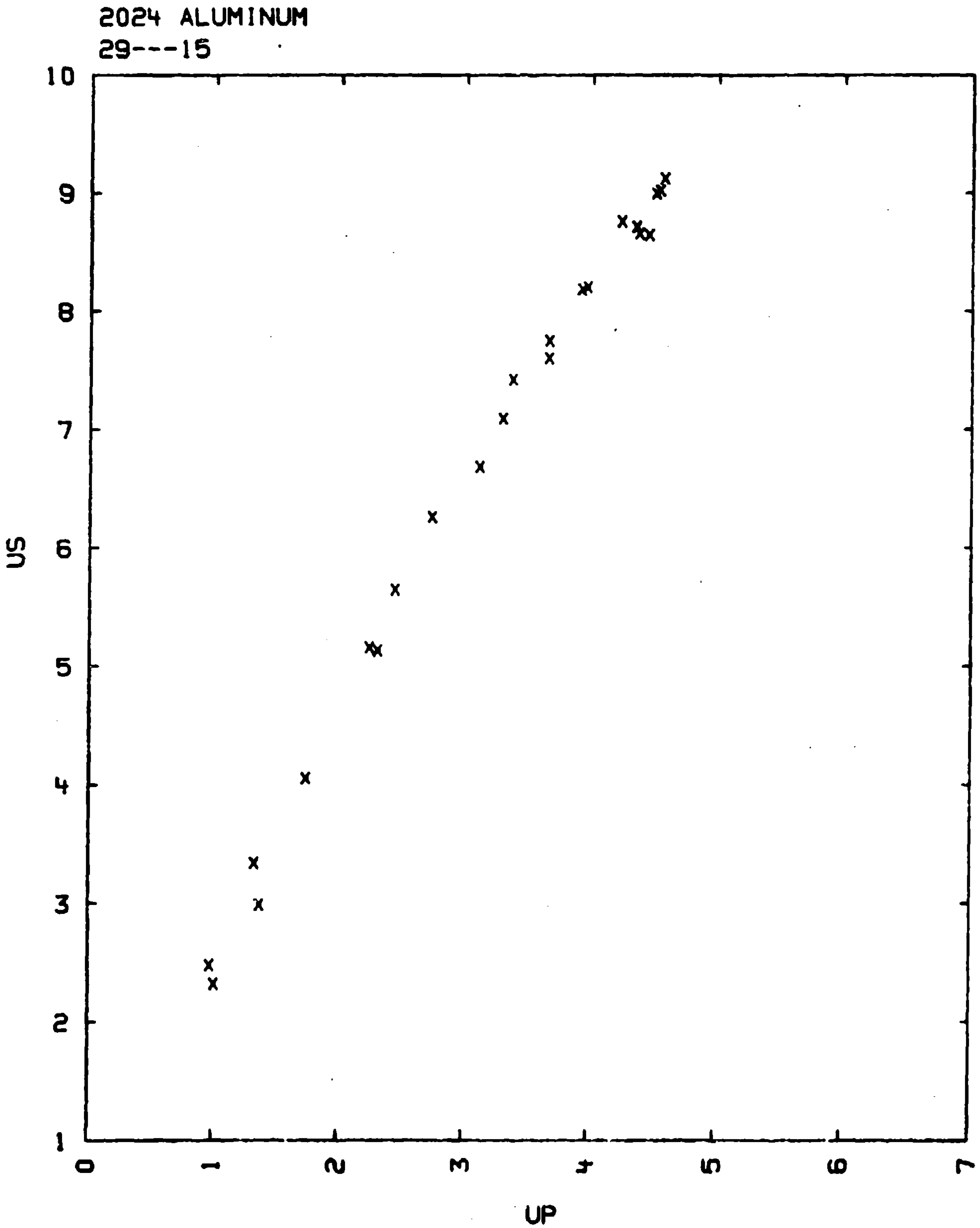


TABLE IX



29---16
921T ALUMINUM

AL	REST	
ZN	0.5 - 1.	WT. PERCENT
CU	3. - 4.	WT. PERCENT
SI	1.1 - 1.35	WT. PERCENT
FE	1.0 MAX	WT. PERCENT
MN	0.5 MAX	WT. PERCENT
MG	0.3 - 0.7	WT. PERCENT
CR	0.15 MAX	WT. PERCENT
TI	0.15 MAX	WT. PERCENT

VO = 0.3519 - 0.3559 CC/G CL = 6.34 KM/SEC CO = 5.20 KM/SEC
CS = 3.14 KM/SEC

IN THE TABLES BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBAR AND DENSITY IN G/CC. THE IMPACTOR IS THE STANDARD.

TABLE I

SAMPLE					STANDARD
RHOO	US	UP	P	V/VO	MATERIAL
2.810	5.72	0.50	80.	0.9126	921T AL
2.810	5.74	0.53	85.	0.9077	921T AL
2.810	5.98	0.63	106.	0.8946	921T AL
2.811	5.88	0.65	107.	0.8895	921T AL
2.828	6.72	1.19	226.	0.8229	921T AL
2.828	7.04	1.40	279.	0.8011	921T AL
2.828	7.18	1.49	303	0.7925	921T AL
2.828	7.21	1.57	320.	0.7822	921T AL
2.828	7.42	1.63	342.	0.7803	921T AL
2.828	7.42	1.63	342.	0.7803	921T AL
2.828	7.73	1.88	407.	0.7594	921T AL
2.828	8.06	2.13	486.	0.7357	921T AL
2.828	8.09	2.13	487.	0.7367	921T AL
2.828	8.35	2.28	538.	0.7268	921T AL
2.828	8.42	2.40	571.	0.7150	921T AL
2.828	8.51	2.44	587.	0.7133	921T AL
2.828	9.07	2.87	736.	0.6836	921T AL
2.828	9.38	3.08	820.	0.6708	921T AL
2.828	9.40	3.10	824.	0.6702	921T AL

US = 5.041 + 1.420*UP KM/SEC HUGONIOT FIT ADOPTED BY THE SOURCE
COMPARISON LEAST SQUARE FITS:
US = A0 + A1*UP KM/SEC

A0 = 5.038 KM/SEC	SIG A0 = 0.027 KM/SEC
A1 = 1.420 -	SIG A1 = 0.013 -
	SIG US = 0.049 -

TABLE II

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
2.812	5.46	0.35	54.	0.9359	2024 AL	5.79
2.812	5.51	0.35	54.	0.9365	2024 AL	5.79
2.838	5.69	0.46	74.	0.9192	2024 AL	5.94
2.812	5.78	0.46	75.	0.9204	2024 AL	5.94
2.812	5.75	0.47	76.	0.9183	2024 AL	5.95
2.812	5.71	0.48	77.	0.9159	2024 AL	5.96
2.814	5.75	0.49	79.	0.9148	2024 AL	5.98
2.812	5.83	0.49	80.	0.9160	2024 AL	5.98
2.812	6.03	0.64	109.	0.8939	2024 AL	6.18
2.812	6.33	0.86	153.	0.8641	2024 AL	6.48
2.842	6.37	0.90	163.	0.8587	2024 AL	6.53
2.814	6.42	0.90	163.	0.8598	2024 AL	6.53
2.842	6.39	0.91	165.	0.8576	2024 AL	6.55
2.842	6.37	0.91	165.	0.8571	2024 AL	6.55
2.842	6.76	1.15	221.	0.8299	2024 AL	6.87
2.842	6.74	1.15	220.	0.8294	2024 AL	6.87
2.814	6.57	1.20	222.	0.8174	2024 AL	6.87
2.842	7.35	1.61	336.	0.7810	2024 AL	7.48
2.814	7.47	1.66	349.	0.7778	2024 AL	7.48
2.842	8.45	2.34	562.	0.7231	2024 AL	7.55
2.842	8.42	2.34	560.	0.7221	2024 AL	8.48
2.803	8.82	2.65	655.	0.6995	2024 AL	8.48
2.842	9.34	3.02	802.	0.6767	2024 AL	8.87
2.842	9.33	3.03	803.	0.6752	2024 AL	9.40
2.842	9.68	3.28	902.	0.6612	2024 AL	9.40
2.842	9.67	3.28	901.	0.6608	2024 AL	9.74
2.838	9.71	3.38	931.	0.6519	2024 AL	9.86
2.838	10.21	3.68	1066.	0.6396	2024 AL	10.28

US = A0 + A1*UP KM/SEC
A0 = 5.089 KM/SEC
A1 = 1.400 -

SIG A0 = 0.021 KM/SEC
SIG A1 = 0.011 -
SIG US = 0.065 -

TABLE III

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
2.838	5.52	0.28	44.	0.9493	CU	4.24
2.842	5.88	0.47	78.	0.9198	CU	4.45
2.814	6.19	0.72	125.	0.8837	CU	4.72
2.838	6.17	0.73	128.	0.8817	CU	4.72
2.814	6.17	0.73	127.	0.8817	CU	4.72
2.838	6.19	0.74	130.	0.8805	CU	4.73
2.812	6.29	0.78	138.	0.8760	CU	4.78
2.842	6.40	0.89	162.	0.8609	CU	4.90
2.838	6.40	0.90	163.	0.8594	CU	4.91
2.838	6.40	0.90	163.	0.8594	CU	4.91
2.822	6.53	0.97	179.	0.8515	CU	4.98
2.842	6.95	1.32	261.	0.8101	CU	5.37

921T ALUMINUM

RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
2.842	7.05	1.38	276.	0.8043	CU	5.44
2.814	7.08	1.44	287.	0.7966	CU	5.49
2.822	7.22	1.44	293.	0.8006	CU	5.51
2.842	7.70	1.86	407.	0.7584	CU	5.97
2.822	8.06	2.09	475.	0.7407	CU	6.23
2.842	8.27	2.32	545.	0.7195	CU	6.48
2.814	8.36	2.33	548.	0.7213	CU	6.49
2.812	8.28	2.51	584.	0.6969	CU	6.68
2.842	8.69	2.59	640.	0.7020	CU	6.79
2.842	8.82	2.73	684.	0.6905	CU	6.93
2.842	8.81	2.73	684.	0.6901	CU	6.94
2.822	9.15	2.93	757.	0.6798	CU	7.16
2.842	9.75	3.33	923.	0.6585	CU	7.62
2.822	9.66	3.37	919.	0.6511	CU	7.65
2.842	9.76	3.38	938.	0.6537	CU	7.67

US = A0 + A1*UP KM/SEC
A0 = 5.207 KM/SEC SIG A0 = 0.027 KM/SEC
A1 = 1.333 - SIG A1 = 0.014 -
SIG US = 0.069 -

TABLE IV

-----SAMPLE-----					-----STANDARD-----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
2.838	6.49	0.95	175.	0.8536	FE	4.93
2.838	7.08	1.36	273.	0.8079		5.49
2.838	8.16	2.14	496.	0.7377	FE	6.53
2.838	8.73	2.64	654.	0.6976	FE	7.15
2.838	9.59	3.24	882.	0.6621	FE	7.90
1.838	9.73	3.28	587.	0.6629	FE	7.96
2.838	9.75	3.36	930.	0.6554	FE	8.05
2.838	10.35	3.76	1104.	0.6367	FE	8.54
2.838	10.30	3.77	1102.	0.6340	FE	8.54

US = A0 + A1*UP KM/SEC
A0 = 5.218 KM/SEC SIG A0 = 0.044 KM/SEC
A1 = 1.358 - SIG A1 = 0.015 -
SIG US = 0.045 -

TABLE V

-----SAMPLE-----					-----STANDARD-----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
2.812	6.29	0.79	140.	0.8744	TU-3 MO	3.37
2.812	6.30	0.79	140.	0.8746	TU-3 MO	3.37
2.812	6.76	1.12	213.	0.8343	TU-3 MO	3.70

921T ALUMINUM

RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
2.842	7.05	1.38	276.	0.8043	CU	5.44
2.814	7.08	1.44	287.	0.7966	CU	5.49
2.822	7.22	1.44	293.	0.8006	CU	5.51
2.842	7.70	1.86	407.	0.7584	CU	5.97
2.822	8.06	2.09	475.	0.7407	CU	6.23
2.842	8.27	2.32	545.	0.7195	CU	6.48
2.814	8.36	2.33	548.	0.7213	CU	6.49
2.812	8.28	2.51	584.	0.6969	CU	6.66
2.842	8.69	2.59	640.	0.7020	CU	6.79
2.842	8.82	2.73	684.	0.6905	CU	6.93
2.842	8.81	2.73	684.	0.6901	CU	6.94
2.822	9.15	2.93	757.	0.6798	CU	7.16
2.842	9.75	3.33	923.	0.6585	CU	7.62
2.822	9.66	3.37	919.	0.6511	CU	7.65
2.842	9.76	3.38	938.	0.6537	CU	7.67

US = A0 + A1*UP KM/SEC
A0 = 5.207 KM/SEC SIG A0 = 0.027 KM/SEC
A1 = 1.333 - SIG A1 = 0.014 -
SIG US = 0.069 -

TABLE IV

---------------SAMPLE-------------------					-----STANDARD-----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
2.838	6.49	0.95	175.	0.8536	FE	4.93
2.838	7.08	1.36	273.	0.8079		5.49
2.838	8.16	2.14	496.	0.7377	FE	6.53
2.838	8.73	2.64	654.	0.6976	FE	7.15
2.838	9.59	3.24	882.	0.6621	FE	7.90
1.838	9.73	3.28	587.	0.6629	FE	7.96
2.838	9.75	3.36	930.	0.6554	FE	8.05
2.838	10.35	3.76	1104.	0.6367	FE	8.54
2.838	10.30	3.77	1102.	0.6340	FE	8.54

US = A0 + A1*UP KM/SEC
A0 = 5.218 KM/SEC SIG A0 = 0.044 KM/SEC
A1 = 1.356 - SIG A1 = 0.015 -
SIG US = 0.045 -

TABLE V

---------------SAMPLE-------------------					-----STANDARD-----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
2.812	6.29	0.79	140.	0.8744	TU-3 MO	3.37
2.812	6.30	0.79	140.	0.8746	TU-3 MO	3.37
2.812	6.76	1.12	213.	0.8343	TU-3 MO	3.70

921T ALUMINUM

RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
2.812	6.87	1.22	236.	0.8224	TU-3 MO	3.81
2.812	6.88	1.22	236.	0.8227	TU-3 MO	3.81
2.814	7.62	1.74	373.	0.7717	TU-3 MO	4.34
2.814	7.60	1.74	372.	0.7711	TU-3 MO	4.34
2.838	7.79	1.77	391.	0.7728	TU-3 MO	4.38
2.838	7.70	1.77	387.	0.7701	TU-3 MO	4.38
2.814	7.94	1.92	429.	0.7582	TU-3 MO	4.53
2.814	7.88	1.93	428.	0.7551	TU-3 MO	4.53
2.838	9.12	2.97	769.	0.6743	TU-3 MO	5.59
2.838	9.10	2.97	767.	0.6736	TU-0 MO	5.59
2.838	10.07	3.72	1063.	0.6306	TU-3 MO	6.35

US = A0 + A1*UP KM/SEC
A0 = 5.358 KM/SEC SIG A0 = 0.052 KM/SEC
A1 = 1.282 - SIG A1 = 0.026 -
SIG US = 0.080 -

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES, HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE A (TABLE I), B (THE REST)
3) TABLE I LISTS THE STANDARD HUGONIOT OBTAINED WITH SYMMETRIC IMPACT. TABLES II THROUGH V CHECK THE INTERNAL CONSISTENCY OF THE OTHER STANDARDS OBTAINED WITH SYMMETRIC IMPACT.
4) ALSO GIVEN ARE V(DP/DE) = 2.10, (DV/DT)/V = 6.87E-5 PER DEG AND CP = 0.877 JOULES PER G. DEG.
5) THE DESIGNATION 921T IS A PIONEER AIUMINUM NOT AN A.S.M. DESIGNATION THE COMPOSITION WAS OBTAINED FROM WAYNE HERRIN, PIONEER ALUMINUM CO. PRIVATE COMMUNICATION (1975).
6) THE 921-T AL PLATE STOCK USED IN TABLE I IS SOMEWHAT POROUS. THE PELLETS ON WHICH THE DATA IN TABLES II THROUGH V WERE OBTAINED ARE MORE NEARLY IDEAL DENSITY

TABLE I

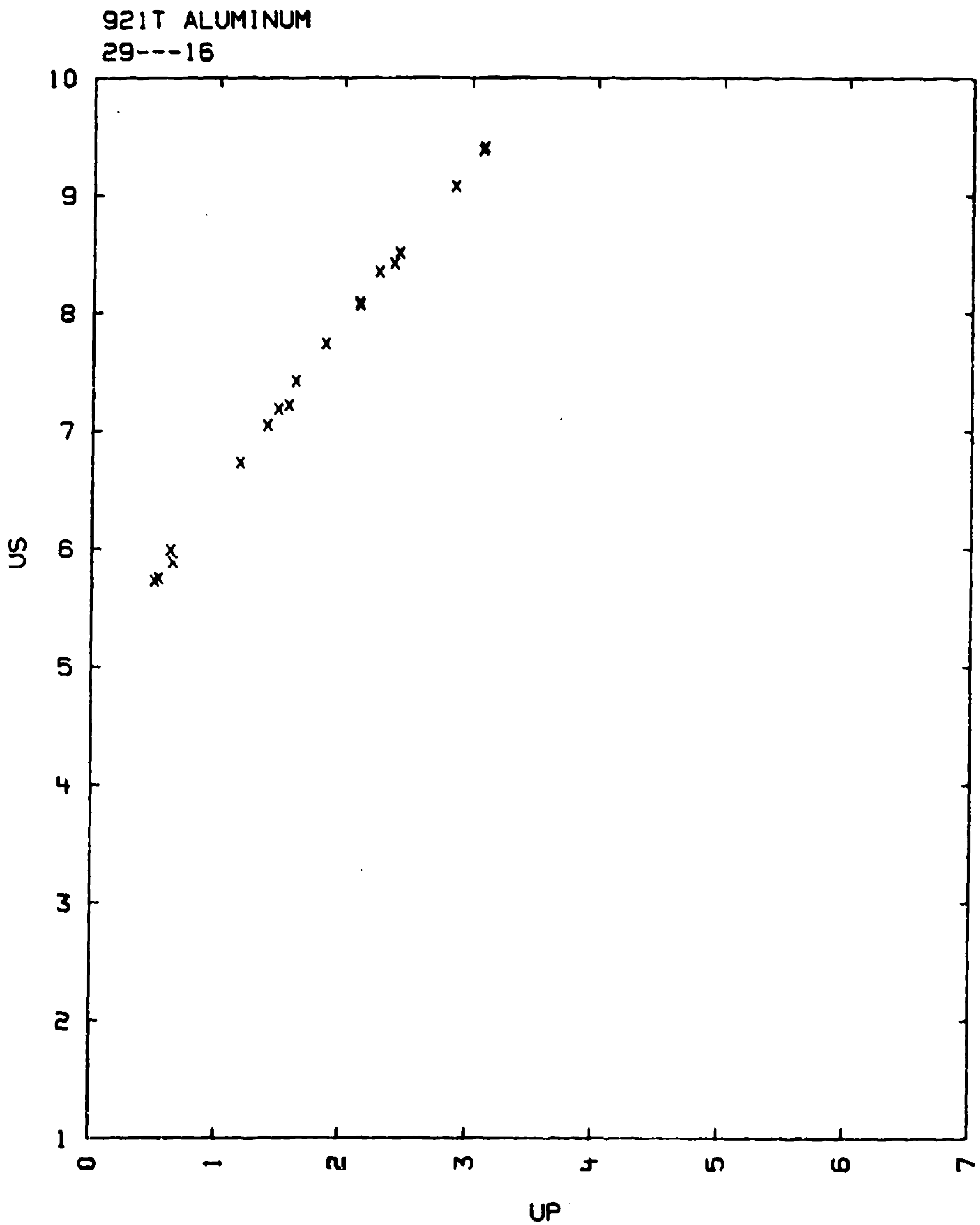


TABLE II

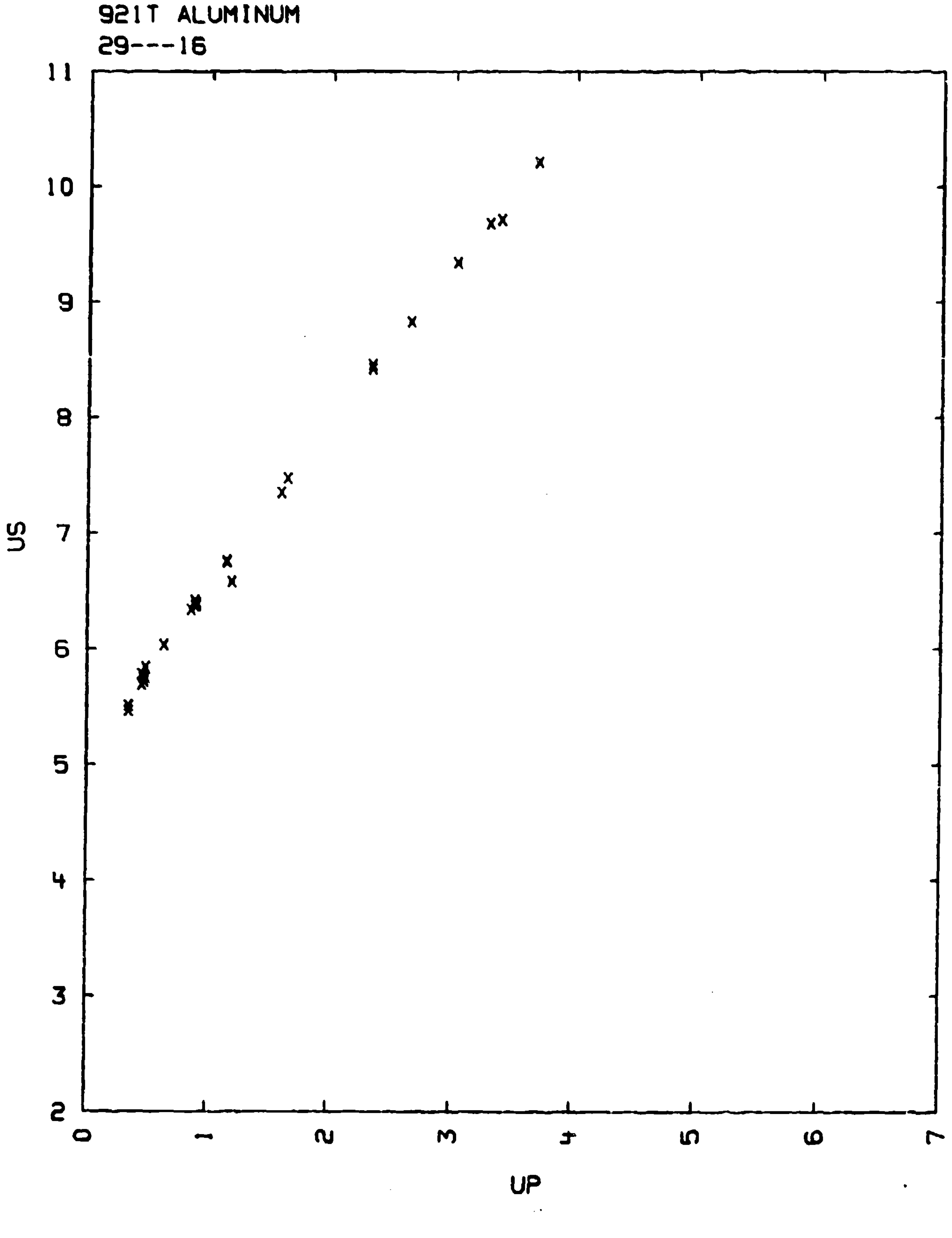


TABLE III

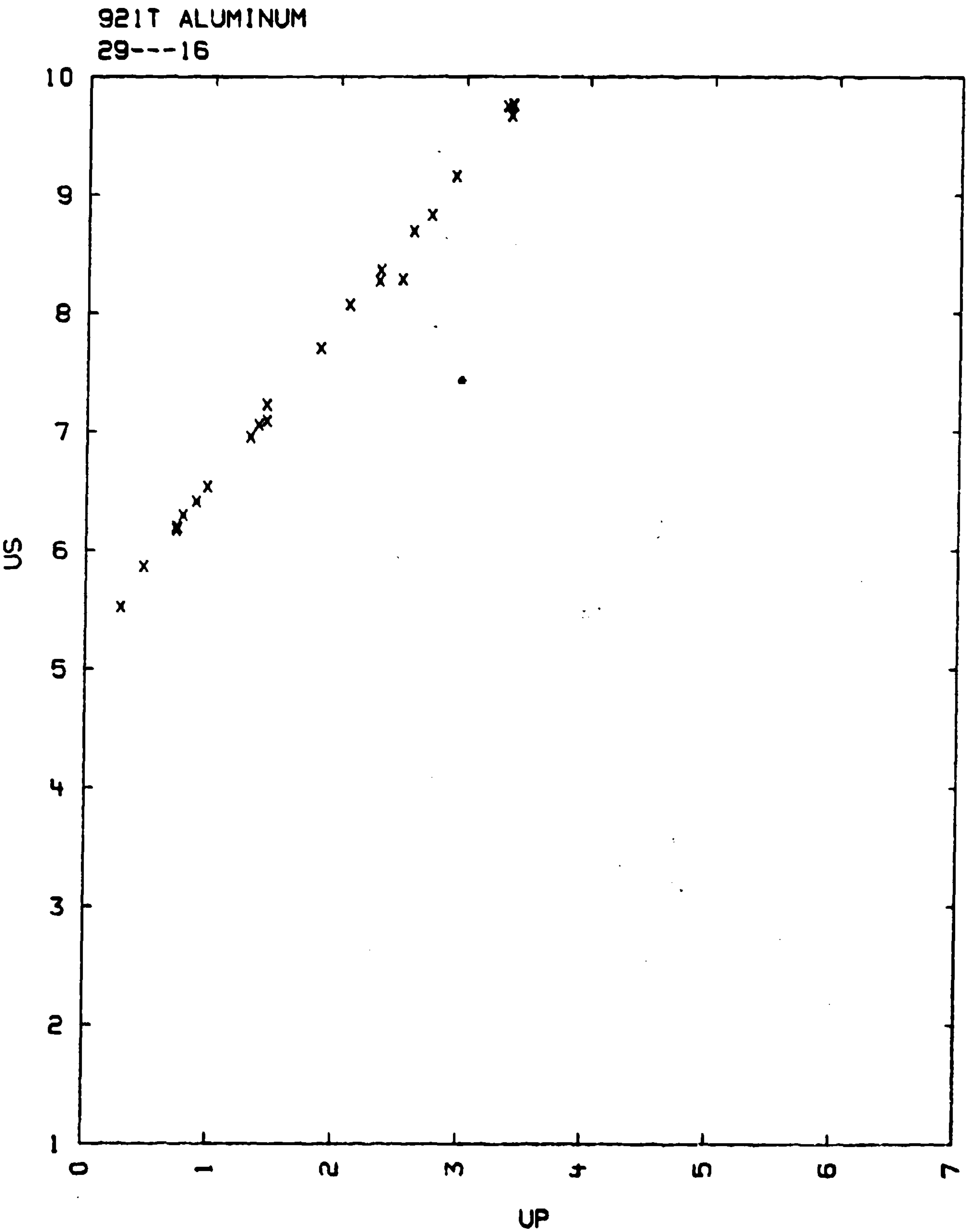


TABLE IV

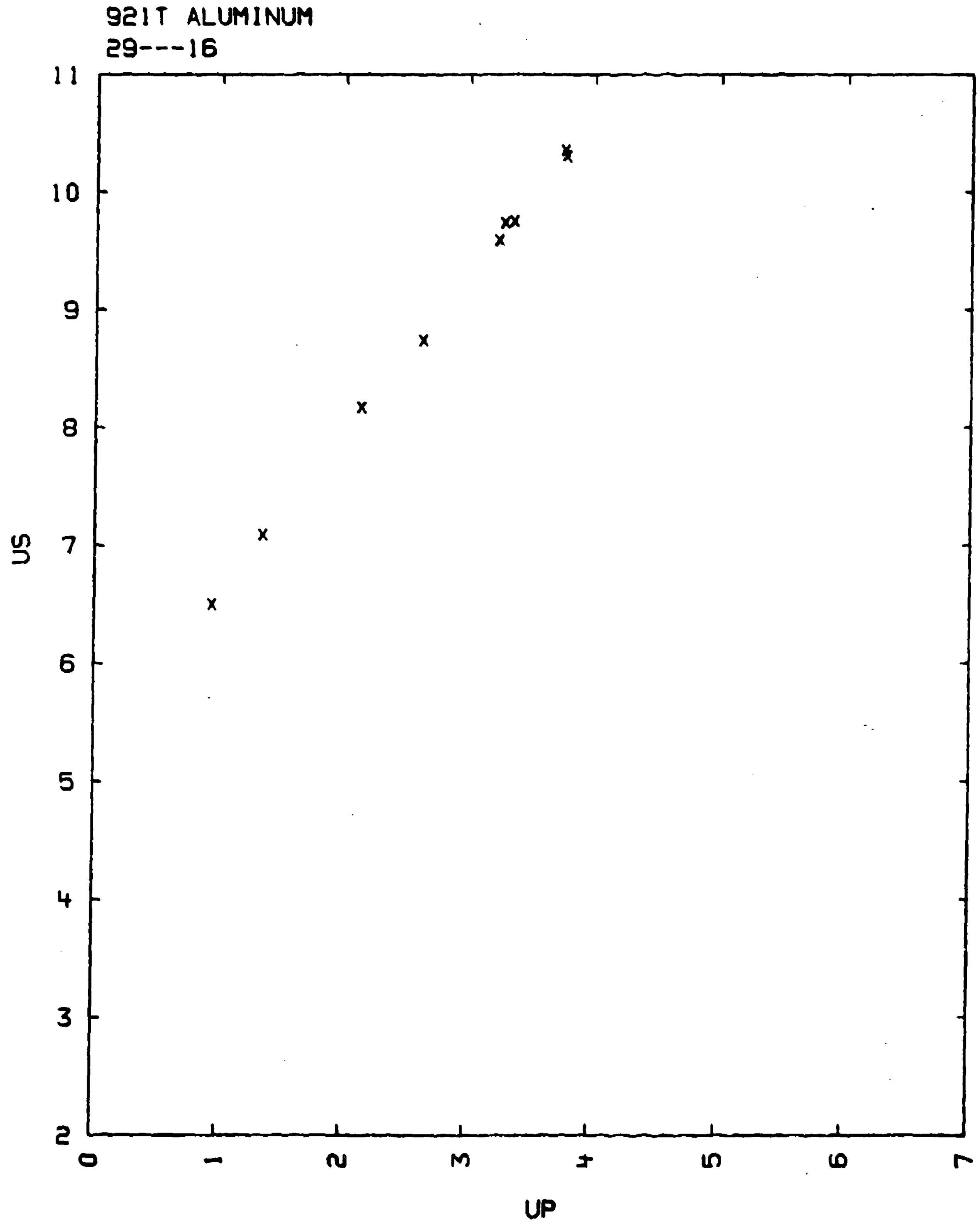
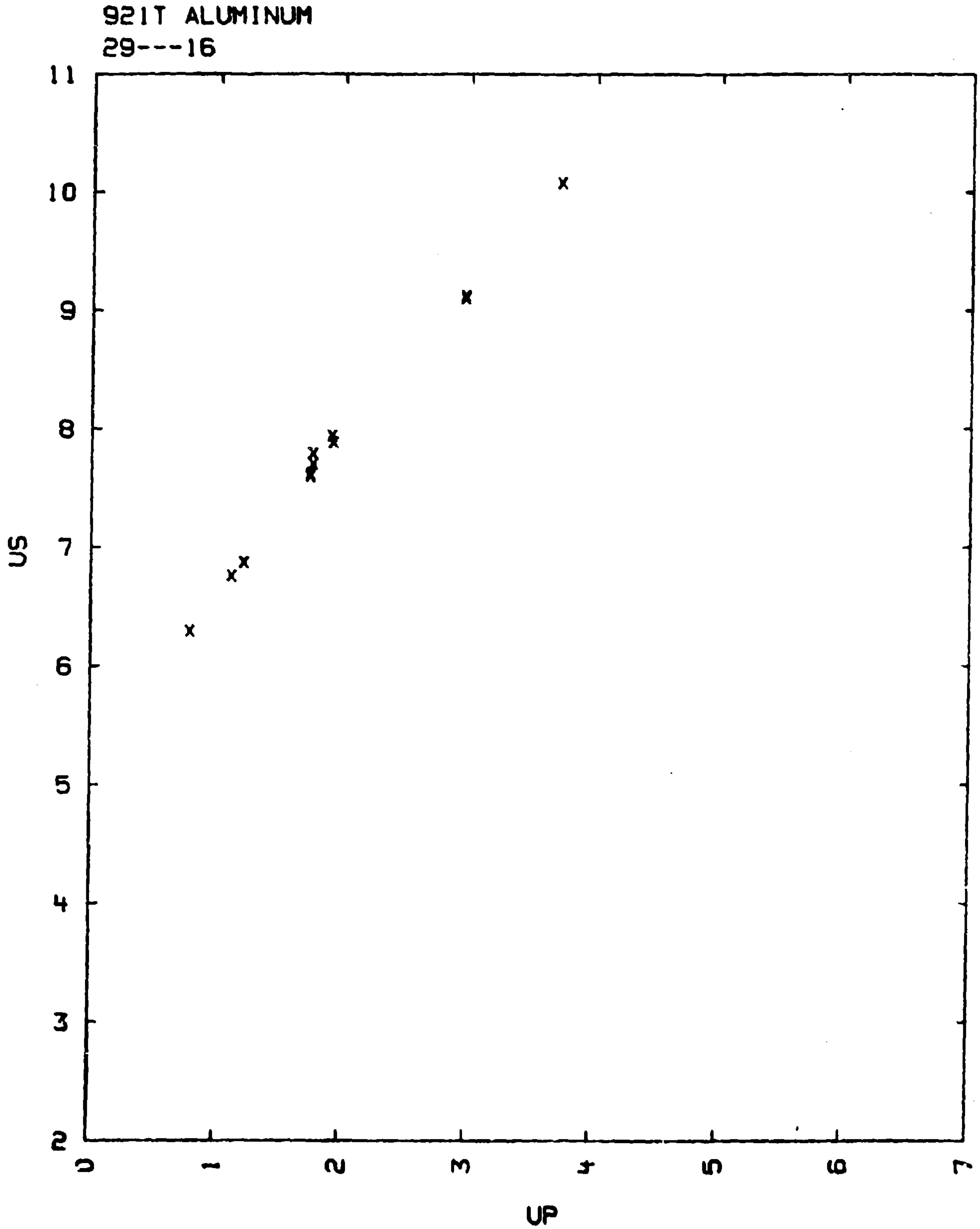


TABLE V



31---1
INDIUM

IN 99.8 PERCENT OR GREATER

VO = 0.1378 CC/G
VOI = 0.1346 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURE IN KILOBARS, AND DENSITY IN G/CC.

TABLE

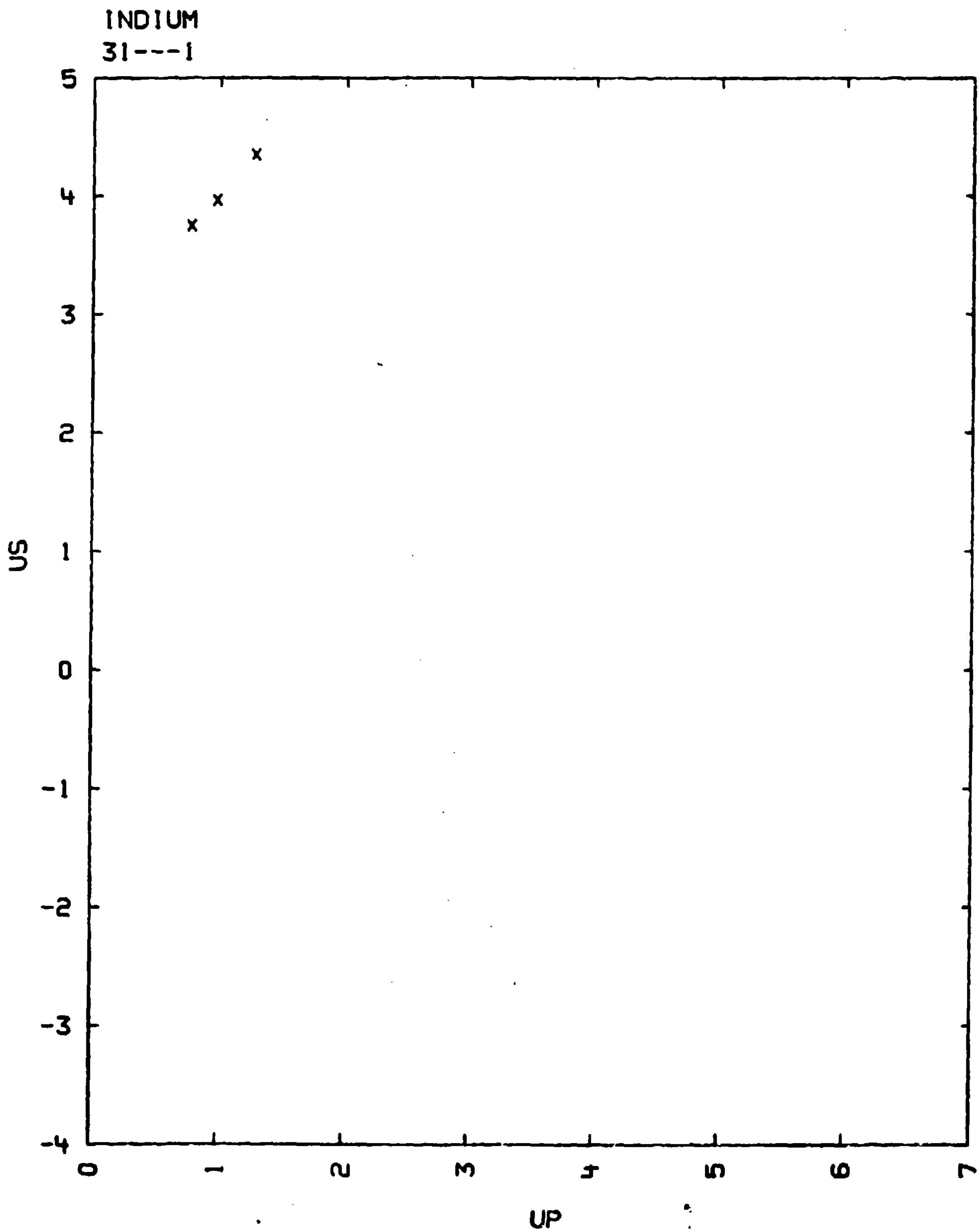
RHOO	US	UP	P	V/VO
7.27	3.745	0.7837	213.5	0.7907
-	3.965	0.9812	283	0.7525
-	4.348	1.281	·405	0.7054

US = 2.783 + 1.218 UP KM/SEC SIGMA US = 0.4 PERCENT

COMMENTS:

1) SOURCE: WALSH, J. M., RICE, M. H., MCQUEEN, R. G. AND YARGER, F. L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS.
4) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 3 PER CENT IN COMPRESSION AT A GIVEN PRESSURE.

TABLE I



31---2
INDIUM

IN 99.5 PERCENT OR GREATER

V0 = 0.1374 CC/G.
V0I = 0.1346 CC/G.

C0 = 2.39 KM/SEC.
CB = 2.33 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURE IN KILOBARS AND DENSITIES IN G/CC.

TABLE

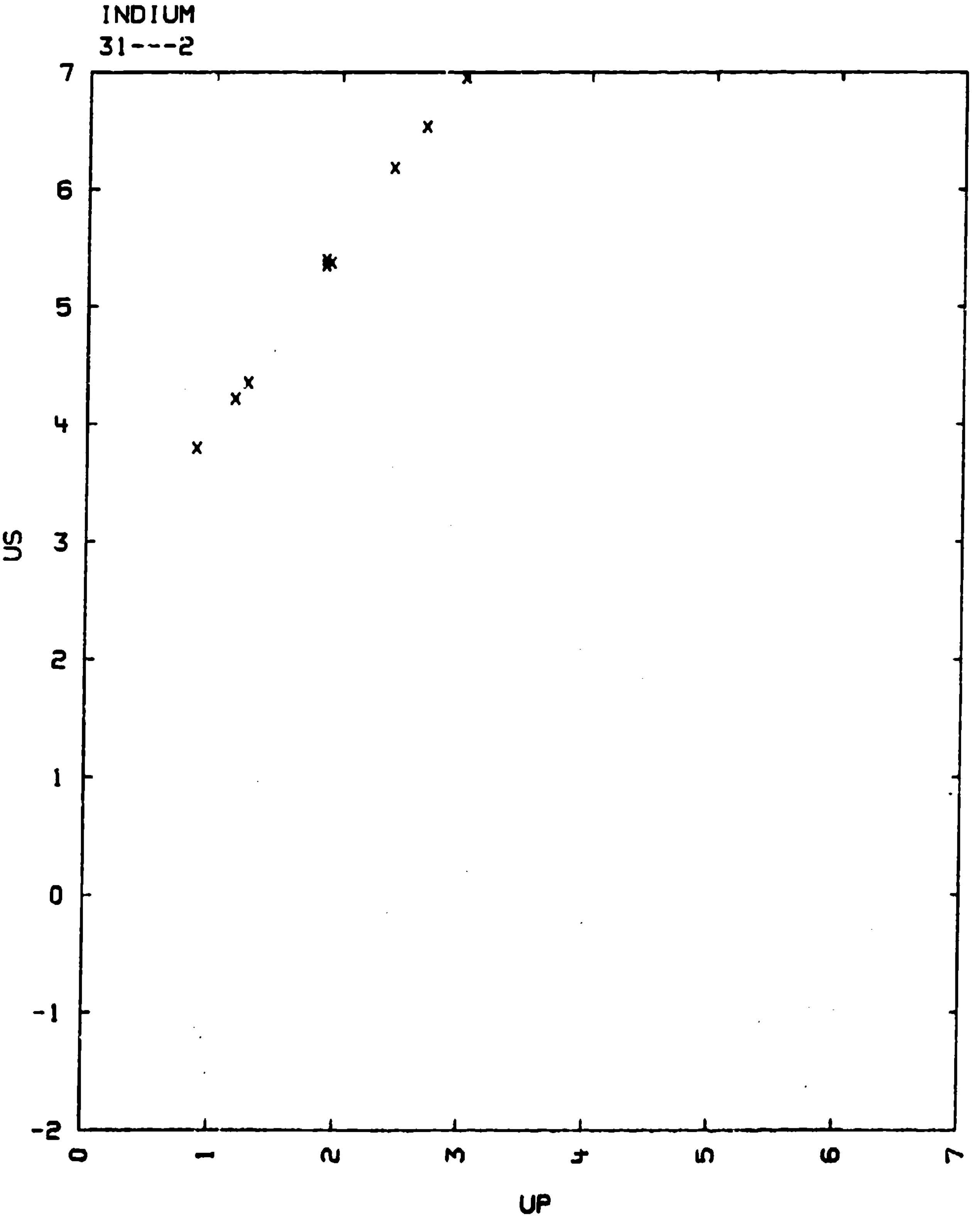
SAMPLE					STANDARD	
RHO 0	US	UP	P	V/V0	RHO0	US
7.28	3.785	0.880	242.5	0.7675	8.934	5.040
-	4.214	1.176	360.8	0.7209	-	5.426
-	4.352	1.274	403.6	0.7073	-	5.556
-	5.346	1.881	732.1	0.6481	-	6.387
-	5.397	1.886	741.0	0.6506	-	6.400
-	5.367	1.927	752.9	0.6410	-	6.443
-	6.172	2.420	1087.4	0.6079	-	7.133
-	6.526	2.675	1270.9	0.5901	-	7.482
-	6.945	2.988	1510.7	0.5698	-	7.910

US = 2.388 + 1.552*UP KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
REPORT NO. GMX-6-566, PP. 51-62 (1964)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS COPPER
3) THE COPPER HUGONIOT IS REPRESENTED BY
US = 3.958 + 1.497 UP KM/SEC.
THE PARTIAL (DE/DP)V = 0.0562 CUBIC CM.
4) V0I WAS TAKEN FROM THE AM. INST. OF PHYS. HANDBOOK (MCGRAW-HILL BOOK CO., N.Y., 1963) 2ND ED.

TABLE I



32---1
THALLIUM

TL 99.8 PER CENT OR GREATER

V0 = 0=08446 CC/G.
V01 = 0.08547 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC.
PRESSURE IN KILOBARS, AND DENSITY IN G/CC.

TABLE

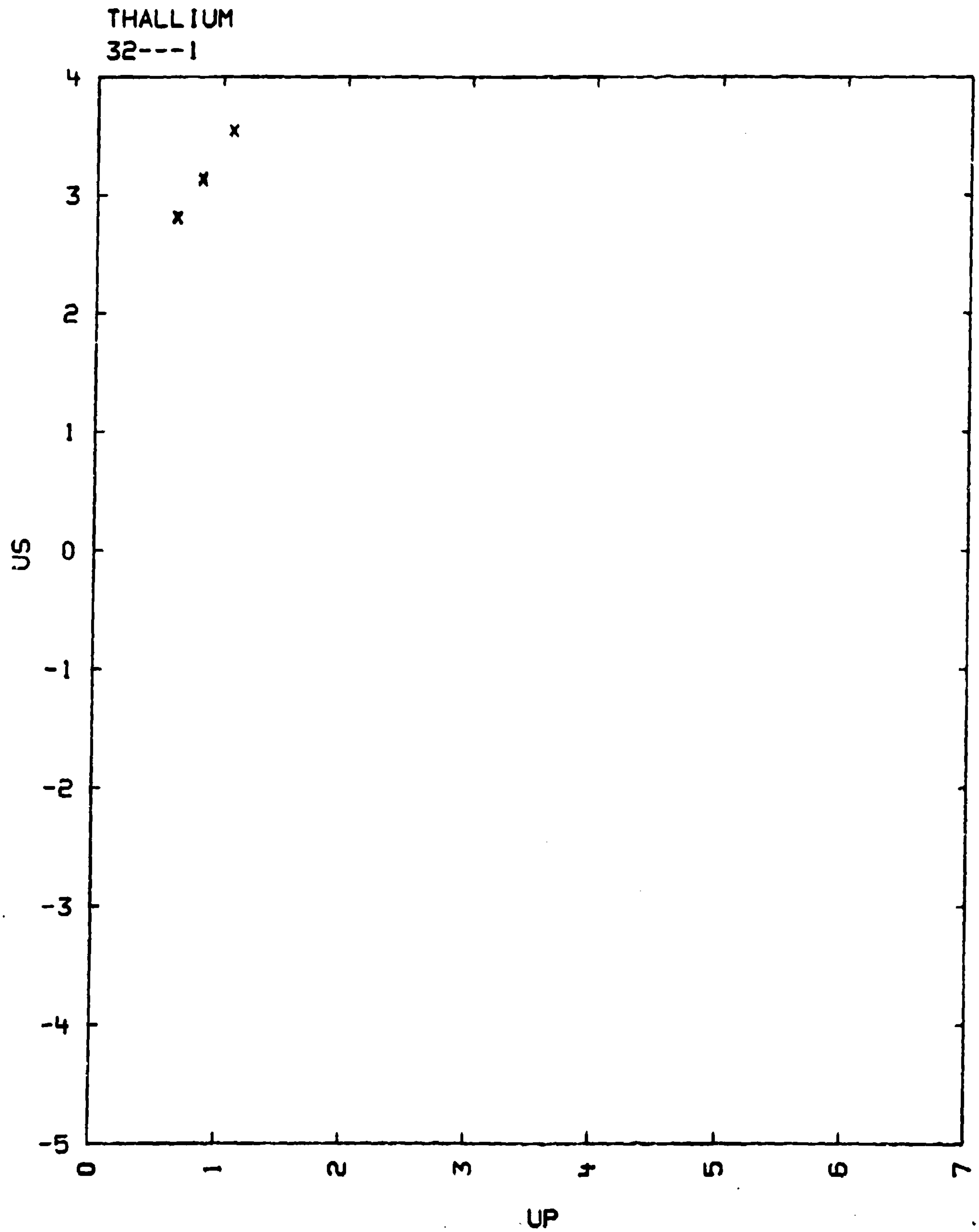
RHOO	US	UP	P	V1V0
11.84	2.804	0.6416	213	0.7712
-	2.817	0.6386	213	0.7733
-	3.120	0.8446	312	0.7293
-	3.145	0.8406	313	0.7327
-	3.538	1.090	456.5	0.6919
-	3.541	1.089	456.5	0.6925

US = 1.770 + 1.623 UP KM/SEC   SIGMA US = 0.4 PERCENT

COMMENTS:

1) SOURCE: WALSH, J.M., RICE, M.H., MCQUEEN, R.G. AND YARGER, F.L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 3 PERCENT IN COMPRESSION AT A GIVEN PRESSURE.
4) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS

TABLE I



32---2
THALLIUM

TL

VO = 0.0845 CC/G.   CO = 1.83 KM/S
VOI = 0.0844 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC.,
PRESSURES IN KILOBARS AND DENSITY IN G/CC.

TABLE

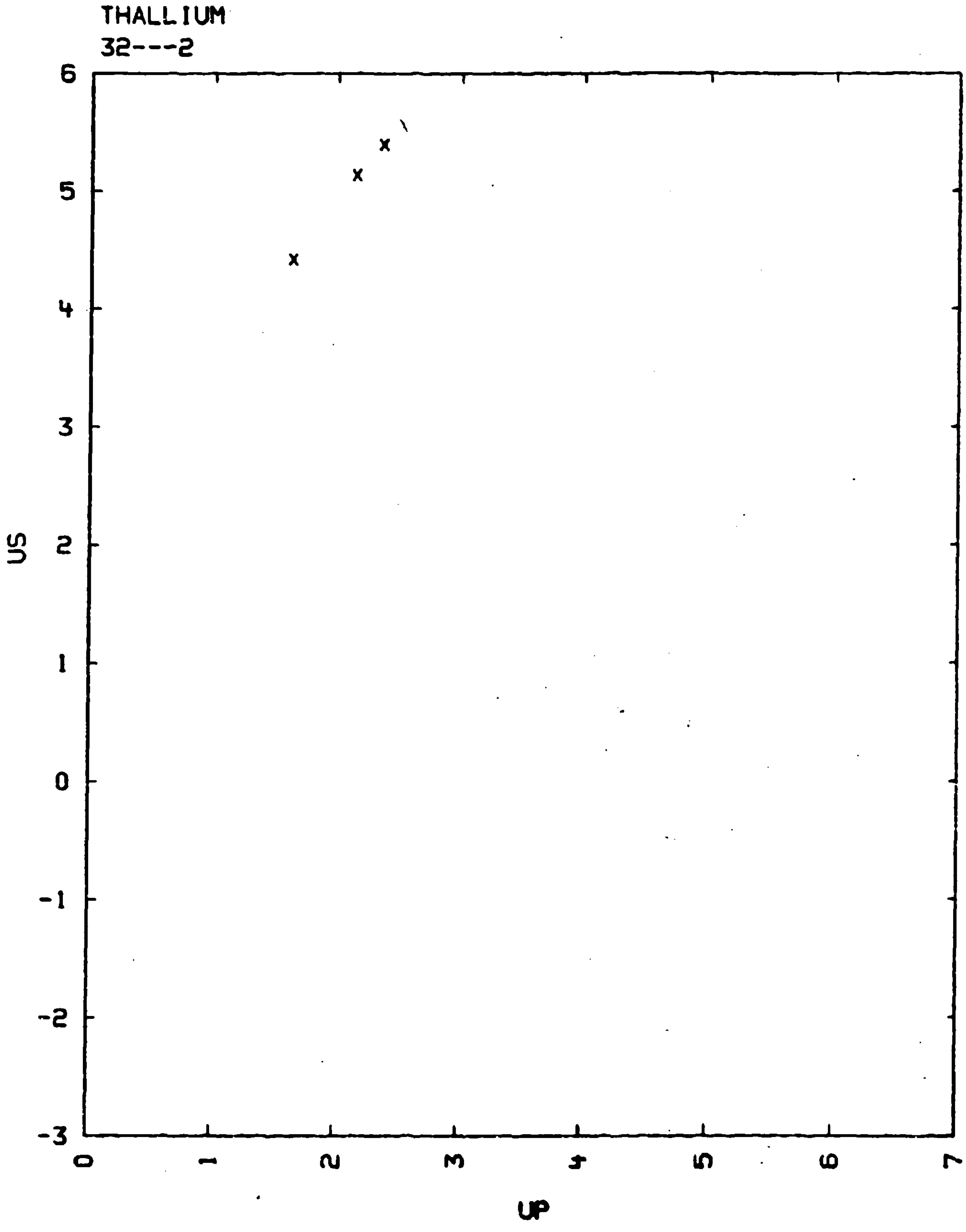
RHOO	US	UP	P	V/VO	PRESSURE IN BRASS STANDARD
11.84	4.42	1.65	864	0.627	860
-	4.41	1.65	862	0.626	860
-	4.41	1.65	862	0.626	860
-	5.13	2.15	1306	0.581	1270
-	5.39	2.37	1515	0.560	1478
-	5.40	2.37	1516	0.561	1478
-	5.40	2.37	1517	0.561	1478

US = 1.859 + 1.515 UP KM/SEC.   SIGMA US = 0.63 PERCENT

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
J. APPL. PHYS., VOL. 31, P. 1253 (1960)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS BRASS
3) FOR THE BRASS STANDARD DATA SEE MATERIAL 36-33
6) VOI WAS TAKEN FROM THE A. I. P. HANDBOOK (MCGRAW HILL BOOK CO.)
2ND ED.

TABLE I



33---0
ZINC, SUMMARY

ZN

V0 = 0.1402 CC/G
V01= 0.1401 CC/G

CB = 3.03 KM/SEC

THE TABLE LISTS HUGONIOT POINTS CALCULATED FROM THE LEAST SQUARE FIT GIVEN BELOW. DENSITY IS IN G/CC, PRESSURE IN KBAR, VELOCITY IN KM/SEC AND ENERGY DIFFERENCE IN KBAR.CC/G.

TABLE

RHO0	US	UP	P	V/V0	E-E0
7.135	3.963	0.6	170.	0.849	1.80
-	4.606	1.0	329.	0.783	5.00
-	5.240	1.4	523.	0.733	9.80
-	6.175	2.0	881.	0.676	20.0
-	7.693	3.0	1647.	0.610	45.0
-	9.158	4.0	2614.	0.563	80.0
-	11.932	6.0	5108.	0.497	180.
-	14.497	8.0	8275.	0.448	320.

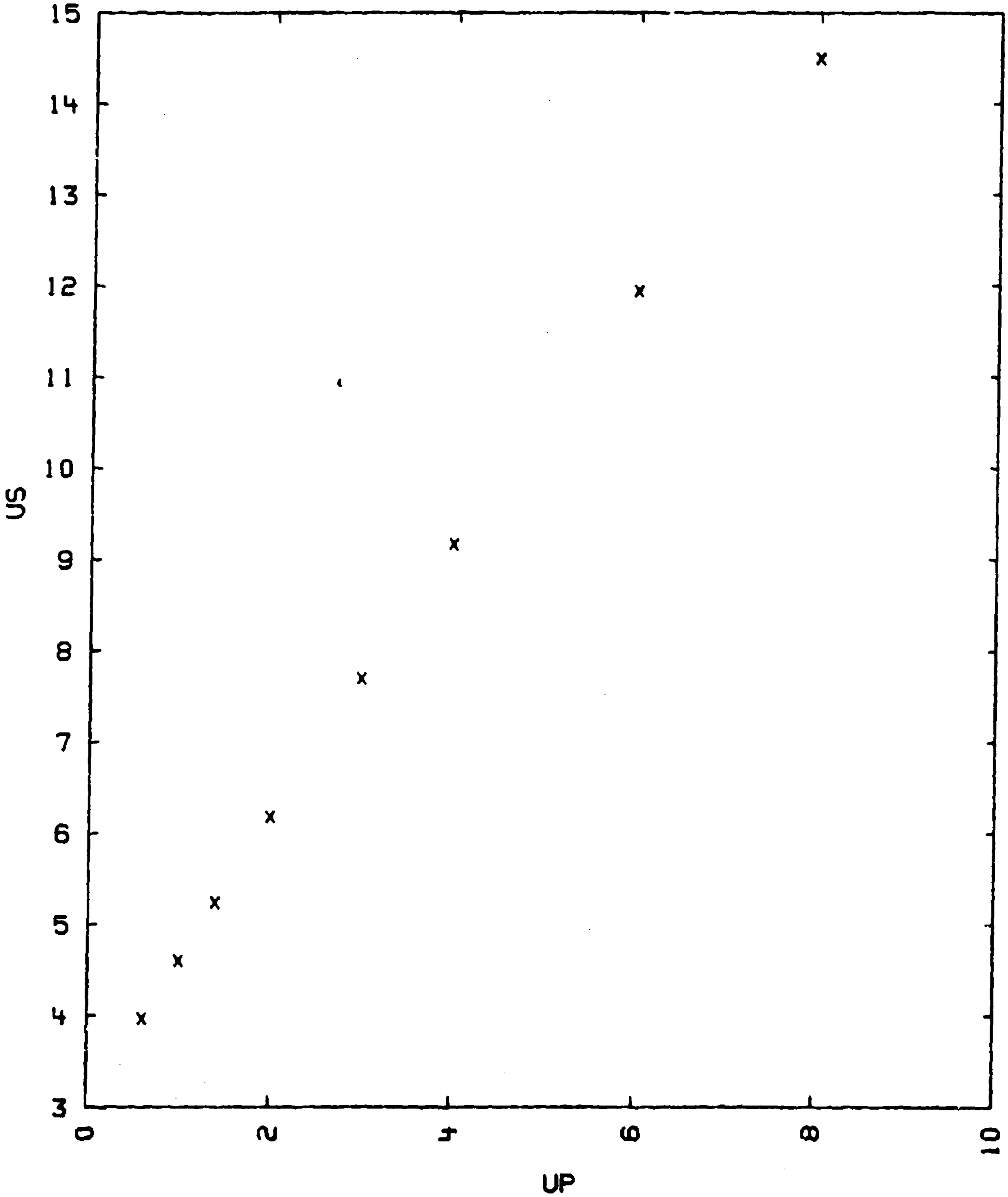
US = 2.984 + 1.648*UP - 0.0261*UP**2, SIG.US = 0.11 KM/SEC.
FOR UP BETWEEN 0.6 AND 8. KM/SEC.

COMMENTS:

1) SOURCE: COMPILER
DATA FROM 33---1,2,3 AND 4 WERE USED FOR THE LEAST SQUARE FIT
2) IF 33---3 TABLE I DATA ARE EXCLUDED THE DATA SUGGEST THAT THE BEST FIT IS OBTAINED FROM TWO STRAIGHT LINES. ADDITION OF TABLE I DATA INDICATES THAT THE UNCERTAINTY AT PRESSURES ABOVE 2 MBAR IS TOO LARGE TO RESOLVE THAT QUESTION.
3) V01 WAS CALCULATED FROM LATTICE CONSTANTS GIVEN BY WYCKOFF, CRYSTAL STRUCTURES VOL. 1 (INTERSCIENCE PUBL., N. Y. 1963).

TABLE I

ZINC, SUMMARY
33---0



33---1
ZINC

ZN 99.8 OR GREATER

VO = 0.1402 CC/G
VOI= 0.1401 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC.
PRESSURE IN KILOBARS, AND DENSITY IN G/CC.

TABLE

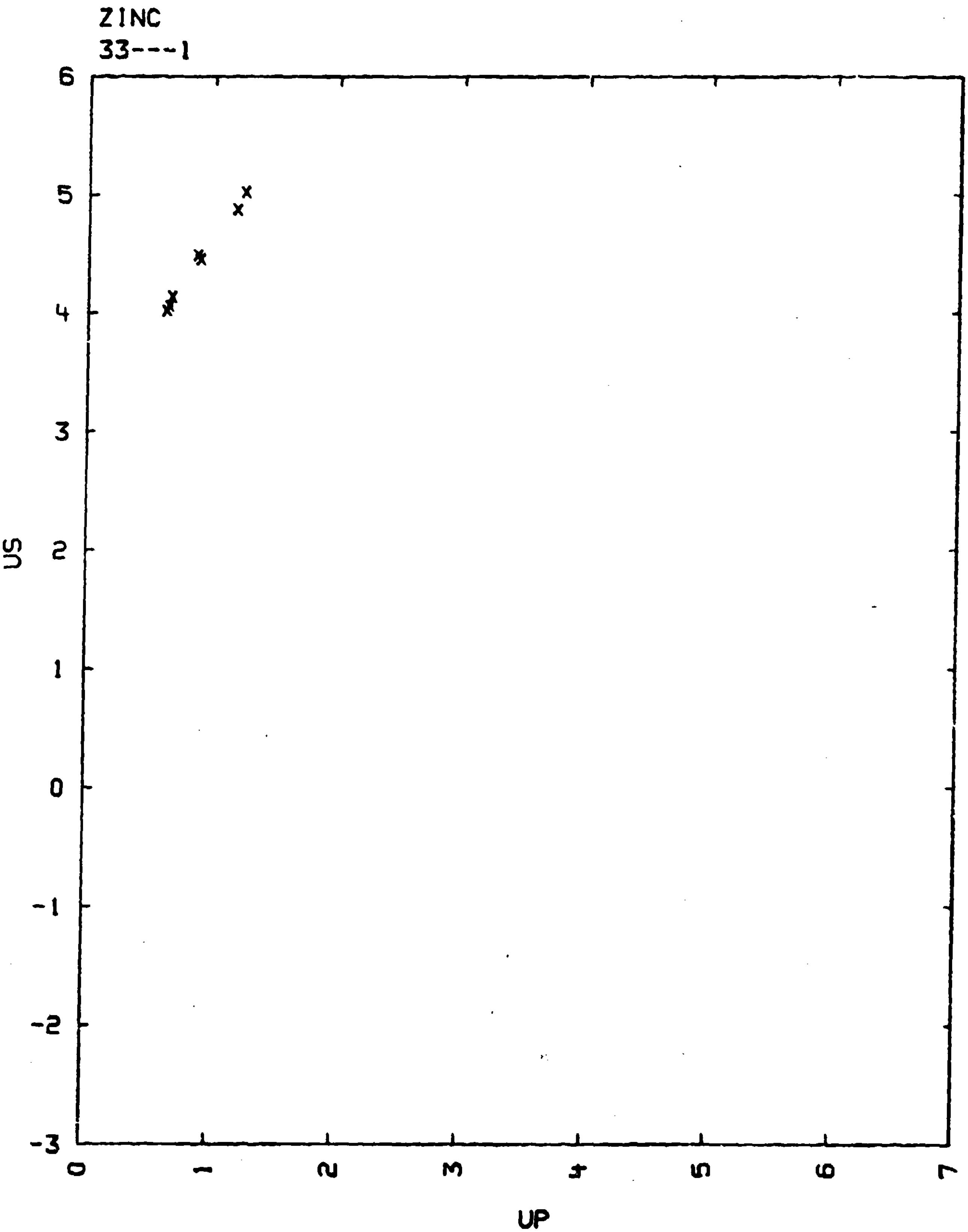
RHOO	US	UFS	UP	P	V/VO
7.135	5.014	2.589	1.250	447	0.7507
-	4.870		1.190	414	0.7556
-	4.481	1.795	0.88	281.4	0.8036
-	4.450	1.826	0.894	283.9	0.7991
-	4.053	1.355	0.650	188.0	0.8396
-	4.13		0.673	198.3	0.8370
-	4.022	1.295	0.630	180.8	0.8434

US = 3.073 + 1.542 UP KM/SEC   SIGMA US = 0.8 PERCENT

COMMENTS:

1) SOURCE: WALSH, J. M., RICE, M. H., MCQUEEN, R. G. AND YARGER, F. L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) THE TOTAL SPREAD IN SHOCK VELOCITIES AT HIGH PRESSURES WAS 1 PER CENT AND THE SPREAD IN SHOCK VELOCITIES FOR PRESSURES BELOW 200 KILOBARS WAS 1.5 PERCENT.
4) THREE ZINC CRYSTALS OF THE FOLLOWING ORIENTATION WERE USED ON EACH SHOT:
A. THE SHOCK PROPAGATION DIRECTION ALONG THE C AXIS
B. THE SHOCK PROPAGATION DIRECTION ALONG THE A AXIS
C. THE SHOCK PROPAGATION DIRECTION BETWEEN TWO A AXES
5) WITHIN EXPERIMENTAL ERROR, THE RESULTS SHOW NO DEPENDENCE OF SHOCK VELOCITY UPON CRYSTALLOGRAPHIC ORIENTATION.

TABLE I



33---2
ZINC

ZN

VO = 0.1401 CC/G CB = 3.03 KM/SEC
VOI = 0.1392 CC/G.

IN THE TABLE BELOW VELOCITIES ARE GIVEN IN MM/MICROSEC.,
PRESSURES IN KILOBARS AND DENSITY IN G/CC.

TABLE

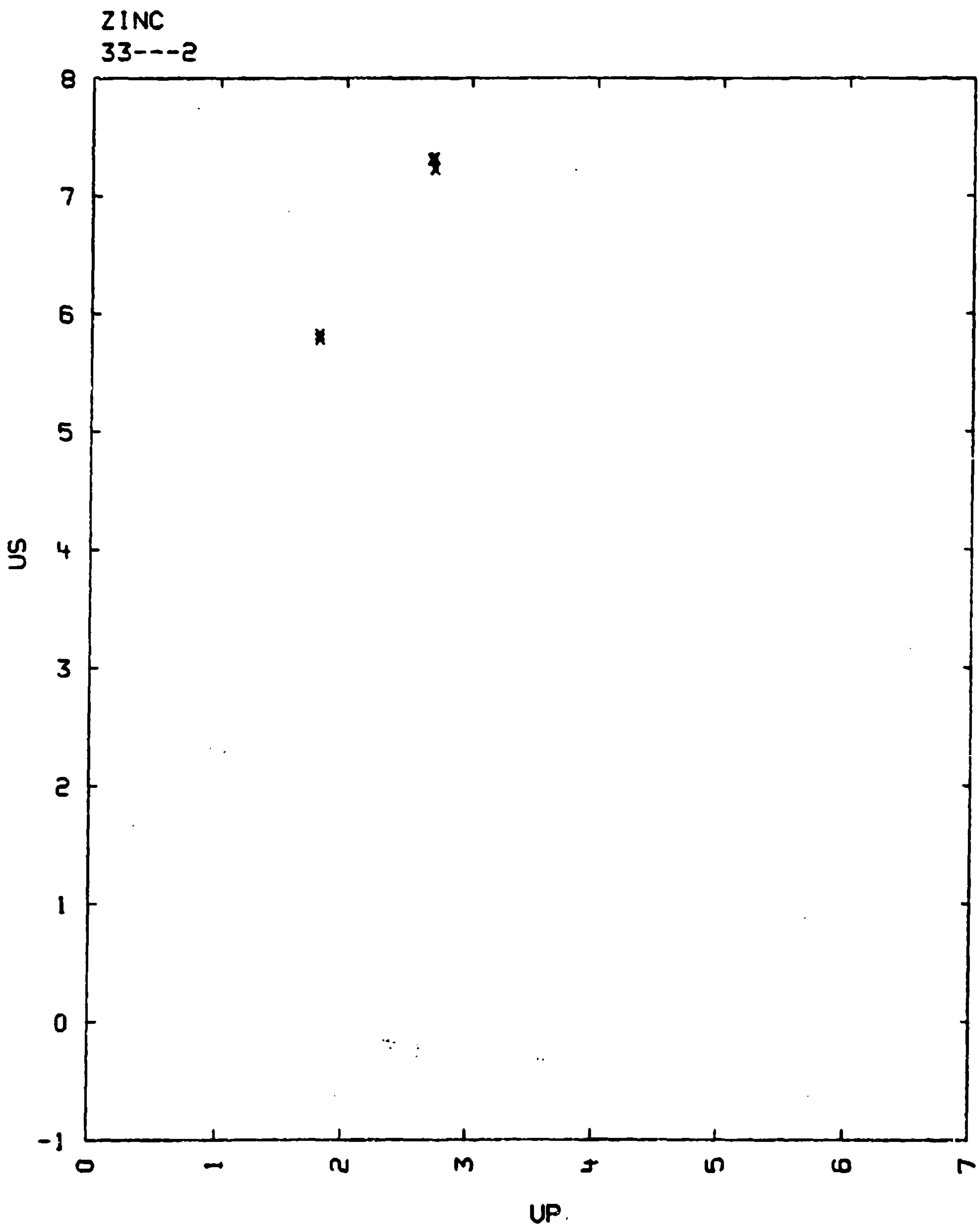
RHOO	US	UP	P	V/VO	PRESSURE IN BRASS STANDARD
7.14	5.81	1.80	745	0.690	853
-	5.82	1.80	747	0.691	853
-	5.78	1.80	743	0.688	853
-	7.22	2.71	1394	0.625	1563
-	7.31	2.71	1416	0.631	1573
-	7.30	2.69	1403	0.631	1560

US = 3.050 + 1.559 UP KM/SEC SIGMA US = 0.45 PERCENT

COMMENTS:

1) SOURCE: MCQUEEN, R. G., AND MARSH, S. P.
J. APPL. PHYS., VOL. 31, P. 1253 (1960)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL USED IS BRASS
3) FOR THE BRASS STANDARD DATA SEE MATERIAL 36-33
2ND ED.
6) VOI WAS TAKEN FROM THE A. I. P. HANDBOOK (MCGRAW HILL BOOK CO.)

TABLE I



33---3
ZINC

ZN

V0 = 0.1401 CC/G.   C0 = 2.851 KM/SEC
V0I = 0.1392 CC/G

IN THE TABLES BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC. ST DESIGNATES THE STANDARD MATERIAL USED AS SAMPLE HOLDER IN TABLE I OR AS STRIKER (PROJECTILE PLATE) IN TABLE II IN TABLE II U(ST) REFERS TO THE TOTAL STRIKER VELOCITY BEFORE IMPACT

TABLE I

------ SAMPLE ------					-- HOLDER ---		
RHOO	US	UP	P	V/V0	ST	US(ST)	UP(ST)
7.14	4.70	1.04	350	0.7813	FE	5.30	0.95
-	6.85	2.41	1179	0.6481	FE	7.53	2.24
-	9.90	4.54	3209	0.5414	FE	10.67*	4.26*

US =

TABLE II

------- SAMPLE ------					STRIKER	
RHOO	US	UP	P	V/V0	ST	U(ST)
7.14	6.30	2.12	954	0.6636	AL	5.60
-	7.92	2.98	1685	0.6234	FE	5.60
-	10.39	4.85	3596	0.5328	FE	9.10
-	14.19	7.78	7860	0.4517	FE	14.68

US = 3.449 + 1.404*UP   OR   US = 2.976 + 1.687*UP - 0.032*UP**2 KM/SEC
SIG US = 0.20   SIG US = 0.12

COMMENTS:

1) SOURCE: AL'TSHULER, L.V., BAKANOVA, A.A. AND TRUNIN, R.F.
SOVIET PHYS.-JETP, VOL. 15, P. 65 (1962)
J. EXPTL. THEORET. PHYS. (USSR) VOL. 42, P. 91, (1962)
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) TABLE I IS CORRECTED DATA WHICH FIRST APPEARED IN THE SOVIET PHYS.-JETP, VOL. 34, P. 614 (1958). THE * VALUES WERE CALCULATED FROM THE IRON STRIKER VELOCITY OF 8.64 KM/SEC.
4) THE INACCURACY IN THE DETERMINATION OF US IN TABLE II TO PRESSURES OF 4187 KILOBARS DID NOT EXCEED 1.0 PERCENT. EACH POINT IS THE AVERAGE OF 4 TO 6 EXPERIMENTS.
5) THE UNCERTAINTY OF THE MEASURED VALUES IN THE LAST ROW ARE:

1 PERCENT IN US, OBTAINED FROM 6-8 EXPERIMENTS AND 1.5 PERCENT IN U(ST) OBTAINED FROM 12 EXPERIMENTS

6) VOI WAS CALCULATED FROM THE HEXAGONAL UNIT CELL WITH
A = 2.6590- AND C = 4.9351 ANGSTROM
AMERICAN INSTITUTE OF PHYSICS HANDBOOK (MCGRAW-HILL 1963) 2ND ED.

7) CO IS GIVEN BY: K. M. SCHRAMM, Z. METALKUNDE, VOL. 53, P. 729 (1962)

TABLE I

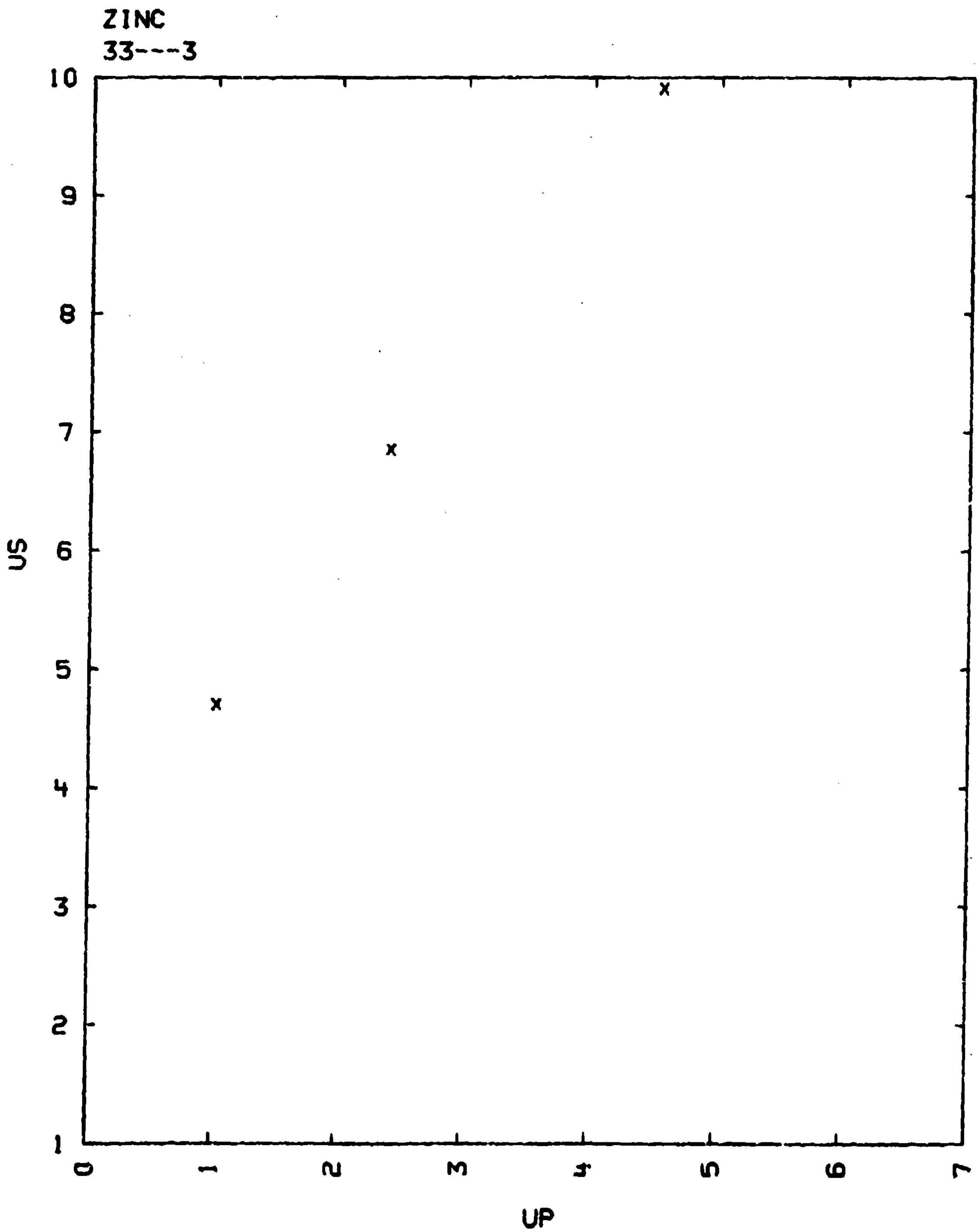
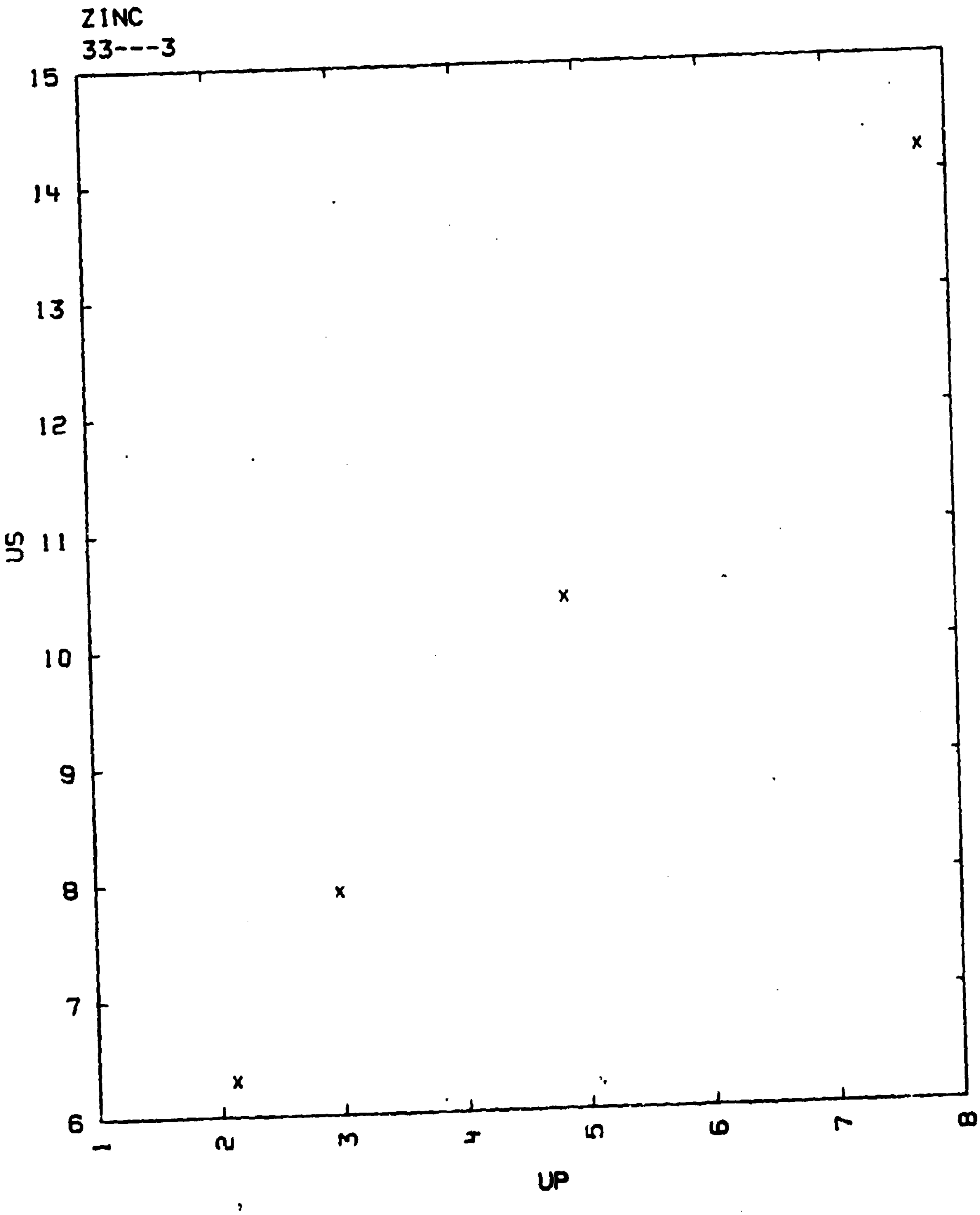


TABLE II



33---4
ZINC

ZN

VO = 0.1403 CC/G
VOI = 0.1402 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN KM/SEC, AND PRESSURE IN KILOBARS.

TABLE

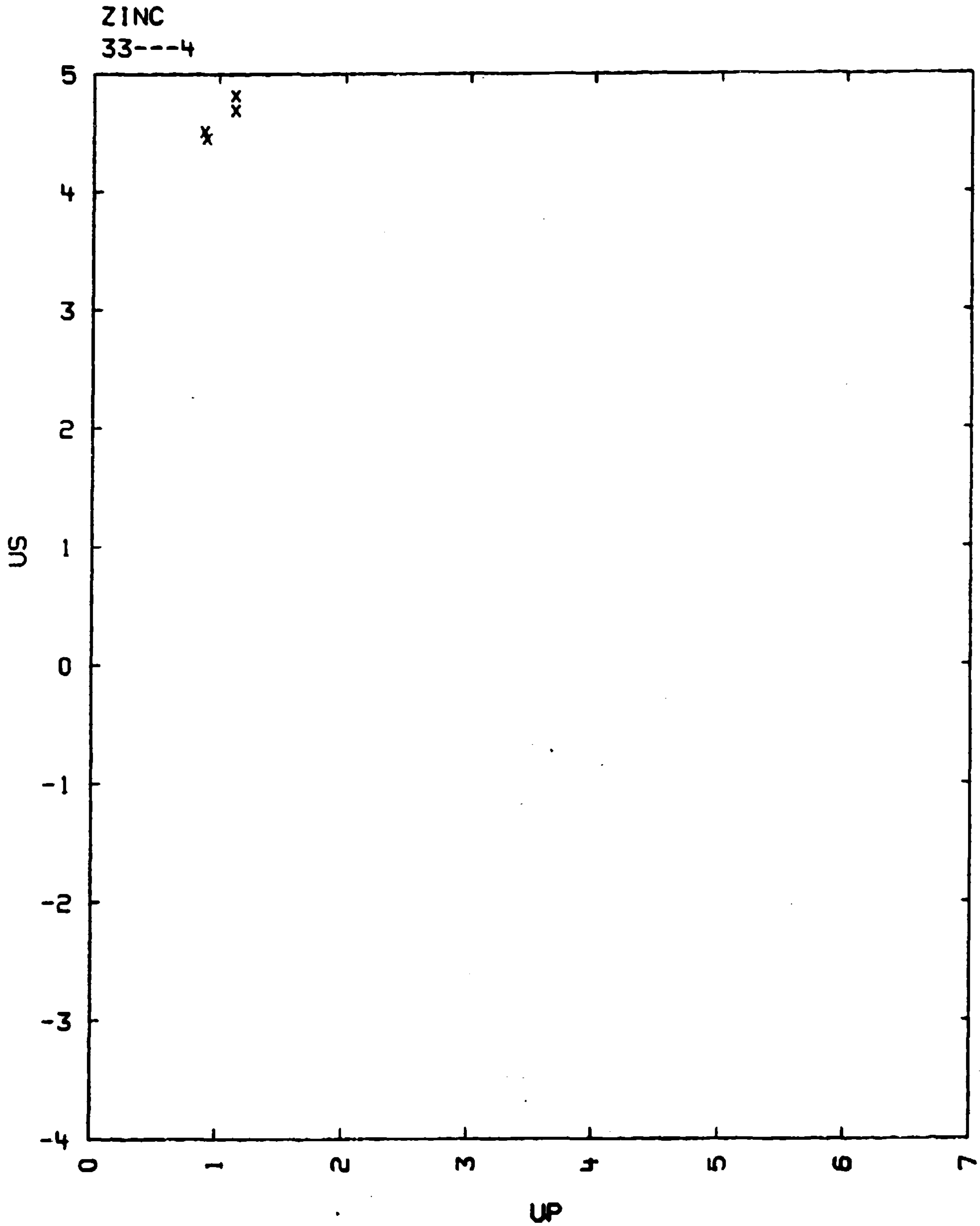
SAMPLE						BASE PLATE
RHOO	US	UFS	UP	P	V/VO	PRESSURE
7.118	4.51	1.83	0.89	286	0.802	224
7.121	4.45		0.91	287	0.797	224
7.129	4.81	2.26	1.13	387	0.765	291
7.138	4.69	2.26	1.13	378	0.760	281

US = 3.44 + 1.16 UP KM/SEC
SIGMA US = 0.073 KM/SEC

COMMENTS:

1) SOURCE: COMPILER
L.R.L. EQUATION OF STATE FILE
LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIFORNIA.
2) EXPERIMENTAL TECHNIQUE B. (ALUMINUM STANDARD BASE PLATE)
DATA REDUCTION TECHNIQUE B.
3) THE VALUE OF VOI WAS OBTAINED FROM A. TAYLOR AND BRENDA J. KAGLE, CRYSTALLOGRAPHIC DATA ON METAL AND ALLOY STRUCTURES (DOVER PUBLICATIONS, INC., NEW YORK, N. Y., 1963).

TABLE I



34---0
CADMIUM, SUMMARY

CD

VO = 0.1157 CC/G
VOI= 0.1157 CC/G

THE TABLE LISTS THE HUGONIOT POINTS CALCULATED FROM THE LEAST SQUARE FIT GIVEN BELOW. UNITS ARE: G/CC, KM/SEC, KBAR AND KBAR.CC/G.

TABLE

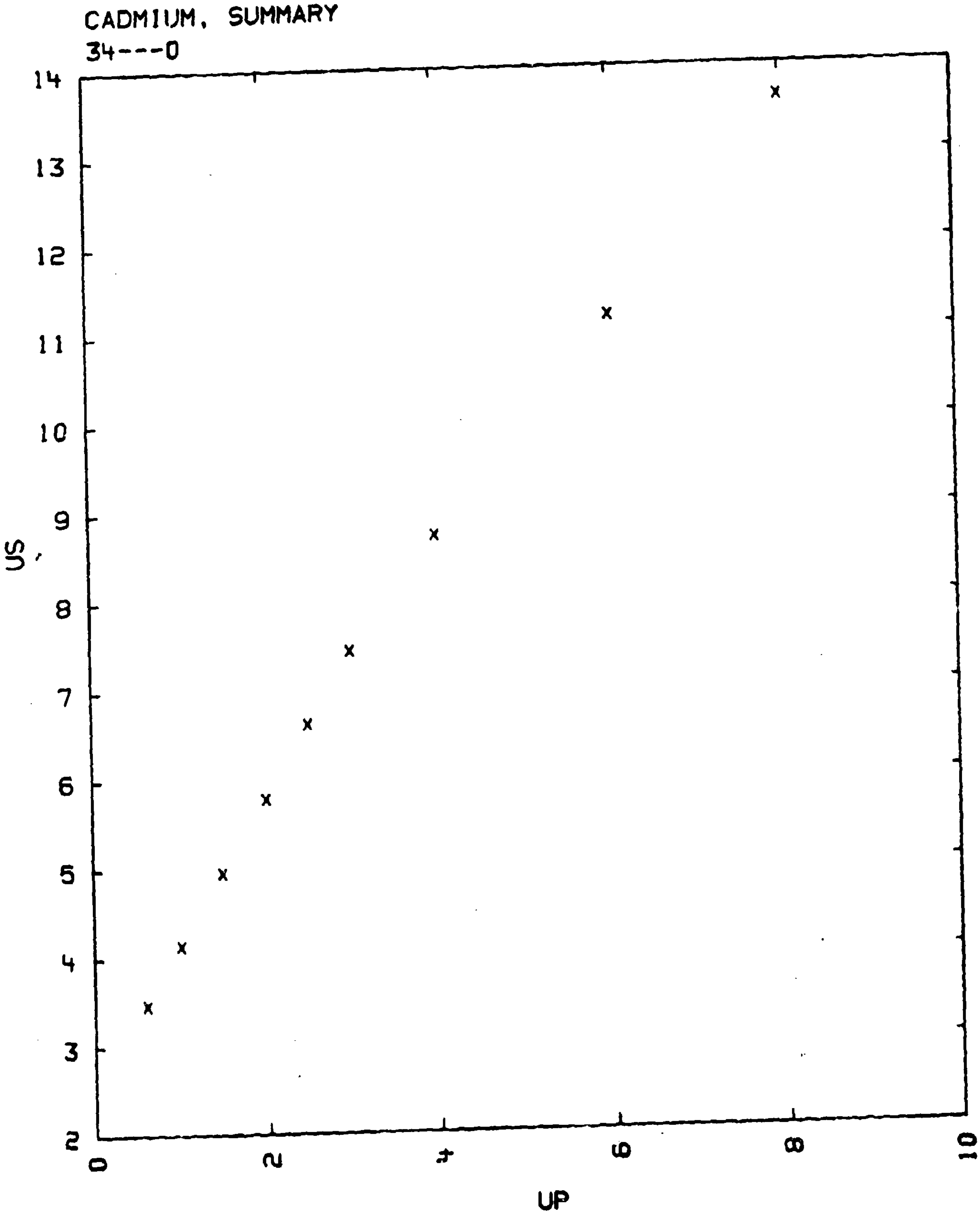
FIT	RHOO	US	UP	P	V/VO	E-EO
1	8.64	3.461	0.6	179	0.827	1.8
1	-	4.124	1.0	356	0.758	5.0
1	-	4.952	1.5	642	0.697	11.25
1	-	5.781	2.0	999	0.654	20.0
1	-	6.609	2.5	1428	0.622	31.25
1	-	7.438	3.0	1928	0.597	45.0
2	-	8.713	4.0	3011	0.541	80.0
2	-	11.165	6.0	5788	0.463	180.0
2	-	13.617	8.0	9412	0.412	320.

US = 2.467 + 1.657*UP, SIG.US = 0.06 KM/SEC
FOR UP BETWEEN 0.6 AND 3.0 KM/SEC
US = 3.809 + 1.226*UP, SIG.UP = 0.04 KM/SEC
FOR UP BETWEEN 4 AND 8

COMMENTS

1) SOURCE: COMPILER
1A) DATA FROM 34---1,2 AND 3 WERE USED FOR THIS FIT.
2) THE ACTUAL SHAPE OF THE HUGONIOT CURVE IS UNCERTAIN BETWEEN UP = 2.9 AND 4.3 KM/SEC, THE HIGHEST POINT ON THE FIRST FIT AND THE LOWEST EXPERIMENTAL POINT ON THE SECOND FIT RESPECTIVELY.

TABLE I



34---1
CADMIUM

CD 99.8 PER CENT OR GREATER

VO = 0.1157 CC/G. CL = 2.78 KM/SEC. CO = 2.17 KM/SEC.

VOI = 0.1168 CC/G. CS = 1.50 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC
PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

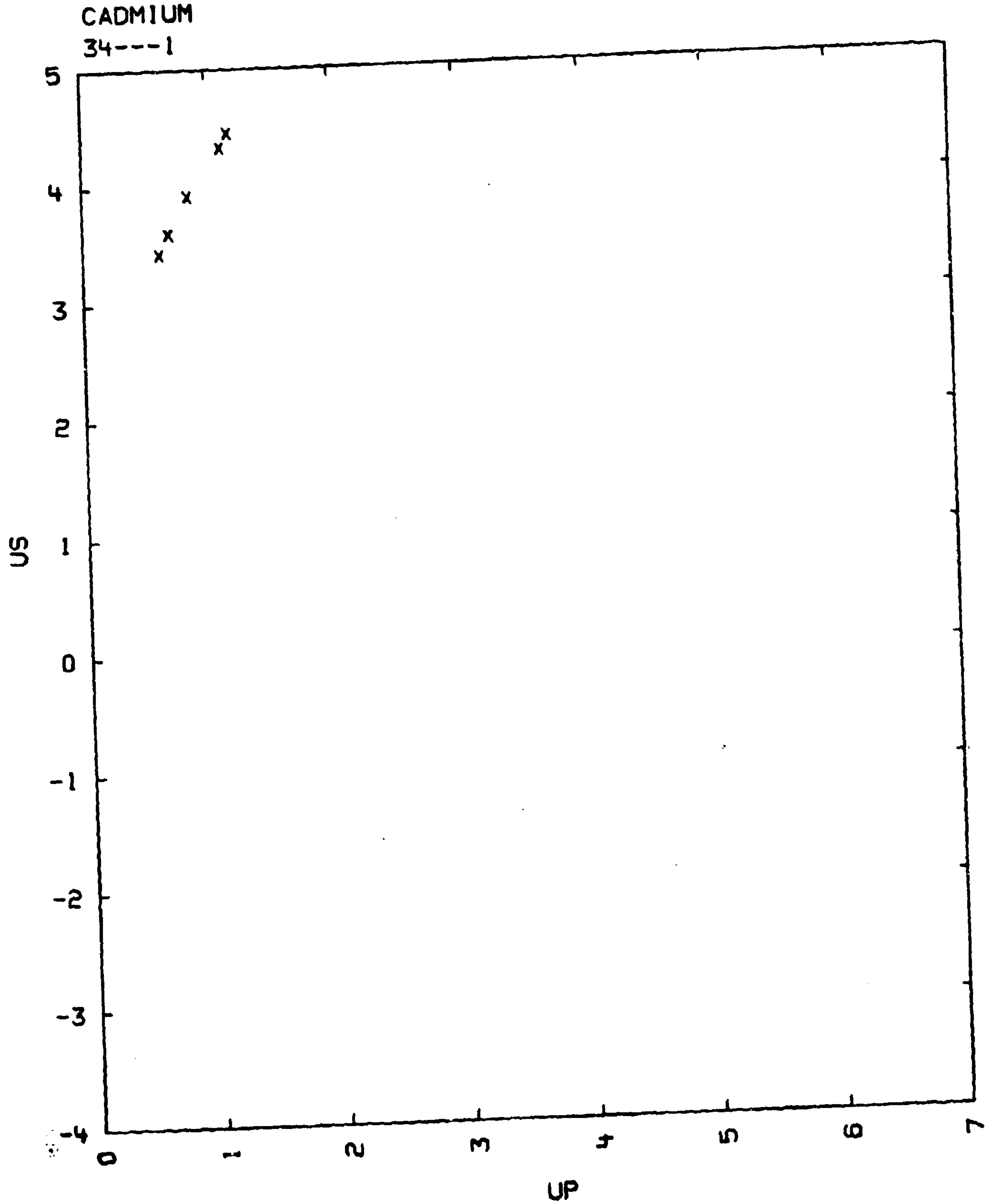
RHOO	US	UFS	UP	P	V/VO
8.64	3.599	1.464	0.690	214.4	0.8083
-	3.421	1.277	0.619	182.9	0.8191
-	3.918	1.757	0.850	287.6	0.7830
-	4.450	2.496	1.190	457.3	0.7326
-	4.324	2.400	1.120	418.2	0.7410

US = 2.379 + 1.749 UP KM/SEC SIGMA US = 1.0 PERCENT

COMMENTS

1) SOURCE: WALSH, J. M., RICE, M. H., MCQUEEN, R. G. AND YARGER, F. L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION TECHNIQUE B.
STANDARD MATERIAL 24ST ALUMINUM
3) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS.
4) CL AND CS WERE OBTAINED FROM L. BERGMAN, DER ULTRASCHALL,
S. HIRZEL VERLAG, STUTTGART, 1954, 6TH ED., P. 650
6) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY
FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 1 PER CENT IN
COMPRESSION AT A GIVEN PRESSURE.

TABLE I



34---2
CADMIUM

CD

VO = 0.116 CC/G
VOI = 0.1157 CC/G

CB = 2.41 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

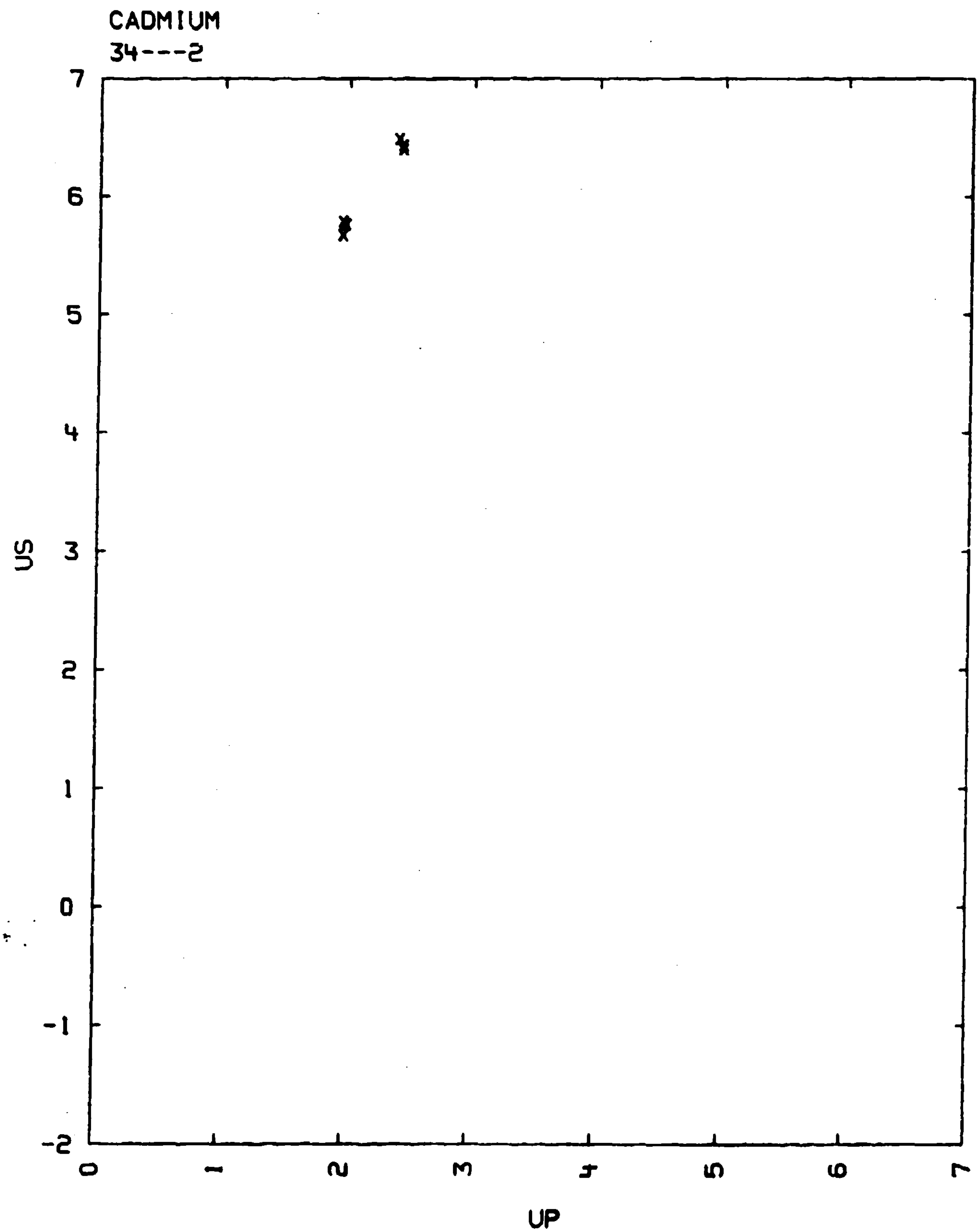
RHOO	US	UP	P	V/VO	PRESSURE IN BRASS STANDARD
8.64	5.66	1.96	957	0.654	1022
-	5.78	1.96	976	0.662	1031
-	5.77	1.96	980	0.663	1034
-	5.77	1.97	982	0.658	1043
-	5.76	1.98	986	0.657	1045
-	6.48	2.40	1339	0.628	1403
-	6.48	2.40	1345	0.629	1406
-	6.39	2.43	1339	0.620	1410
-	6.43	2.43	1351	0.620	1421

US = 2.443 + 1.671 UP KM/SEC. SIGMA US = 0.58 PERCENT

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
J. APPL. PHYS., VOL. 31, P. 1253 (1960)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS BRASS
3) FOR THE BRASS STANDARD DATA SEE MATERIAL 36-33
4) VOI WAS TAKEN FROM THE AM. INST. OF PHYS. HANDBOOK (MCGRAW-HILL BOOK CO., N.Y., 1963) 2ND ED.

TABLE I



34---3
CADMIUM

CD

V0 = 0.1157 CC/G.
V01 = 0.1157 CC/G. CO = 2.245 KM/SEC.

IN THE TABLES BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC. ST DESIGNATES THE STANDARD MATERIAL USED AS SAMPLE HOLDER IN TABLE I OR AS STRIKER (PROJECTILE PLATE) IN TABLE II U(ST) REFERS TO TOTAL STRIKER VELOCITY BEFORE IMPACT.

TABLE I

- - - - - - SAMPLE	- - - - - -				- - HOLDER - - -		
RHO0	US	UP	P	V/V0	ST	US(ST)	UP(ST)
8.64	4.10	1.02	360	0.7519	FE	5.30	0.95
-	6.32	2.31	1261	0.6345	FE	7.53	2.24
-	9.14	4.36	3443	0.5230	FE	10.67*	4.26*

US = SEE BELOW

TABLE II

- - - - - - - SAMPLE	- - - - - -				STRIKER	
RHO0	US	UP	P	V/V0	ST	U(ST)
8.64	5.88	1.99	1010	0.6614	AL	5.60
-	7.16	2.88	1788	0.5974	FE	5.60
-	9.55	4.67	3850	0.5107	FE	9.10
-	12.99	7.49	8410	0.4234	FE	14.68

US = 3.112 + 1.349*UP OR US = 2.486 + 1.739*UP -0.045*UP**2 KM/SEC
SIG US = 0.24 SIG US = 0.10

COMMENTS:

1) SOURCE: AL'TSHULER, L.V., BAKANOVA, A.A. AND TRUNIN, R.F.
SOVIET PHYS.-JETP, VOL. 15, P. 65 (1962)
J. EXPTL. THEORET. PHYS. (USSR) VOL. 42, P. 91, (1962)
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B
3) TABLE I IS CORRECTED DATA WHICH FIRST APPEARED IN THE SOVIET PHYS.-JETP, VOL. 34, P. 614 (1958). THE * VALUES WERE CALCULATED FROM THE IRON STRIKER VELOCITY OF 8.64 KM/SEC.
4) THE INACCURACY IN THE DETERMINATION OF US IN TABLE 2 TO PRESSURES OF 4187 KILOBARS DID NOT EXCEED 1.0 PERCENT. EACH POINT IS THE AVERAGE OF 4 TO 6 EXPERIMENTS.
5) THE U UNCERTAINTY OF THE VALUES IN THE LAST TABLE ENTRY ARE:

1 PERCENT IN US, OBTAINED FROM 6-8 EXPERIMENTS AND 1.5 PERCENT IN
U(ST) OBTAINED FROM 12 EXPERIMENTS.
6) VOI WAS OBTAINED FROM THE HEXAGONAL UNIT CELL, WITH:
A = 2.9796 AND C = 5.6171 ANGSTROM
AMERICAN INST. OF PHYS. HANDBOOK (MCGRAW-HILL BOOK CO., N.Y., 1963)
2ND ED.
7) CO IS GIVEN BY: K. M. SCHRAMM, Z. METALKUNDE, VOL. 53, P. 729 (1962)

TABLE I

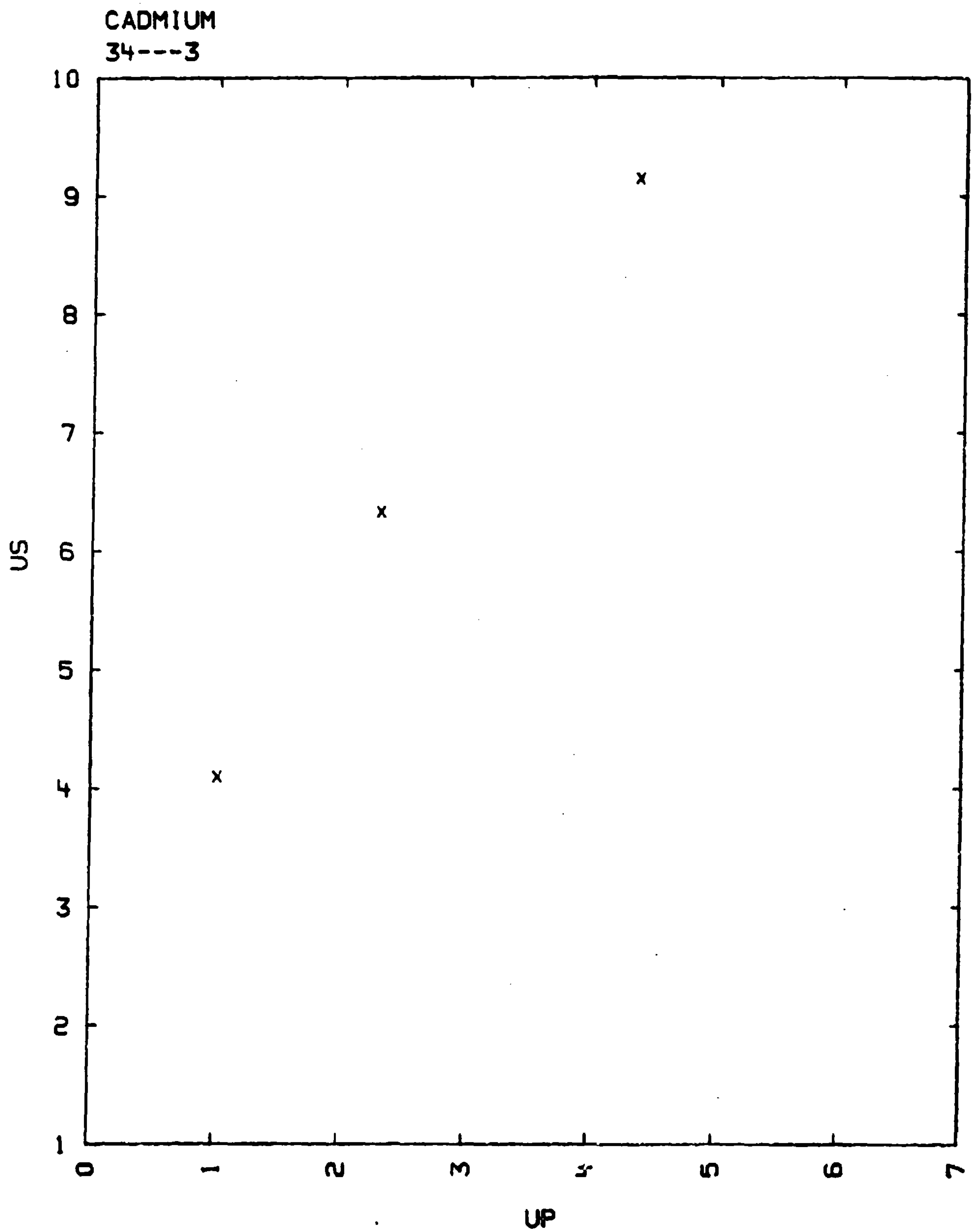
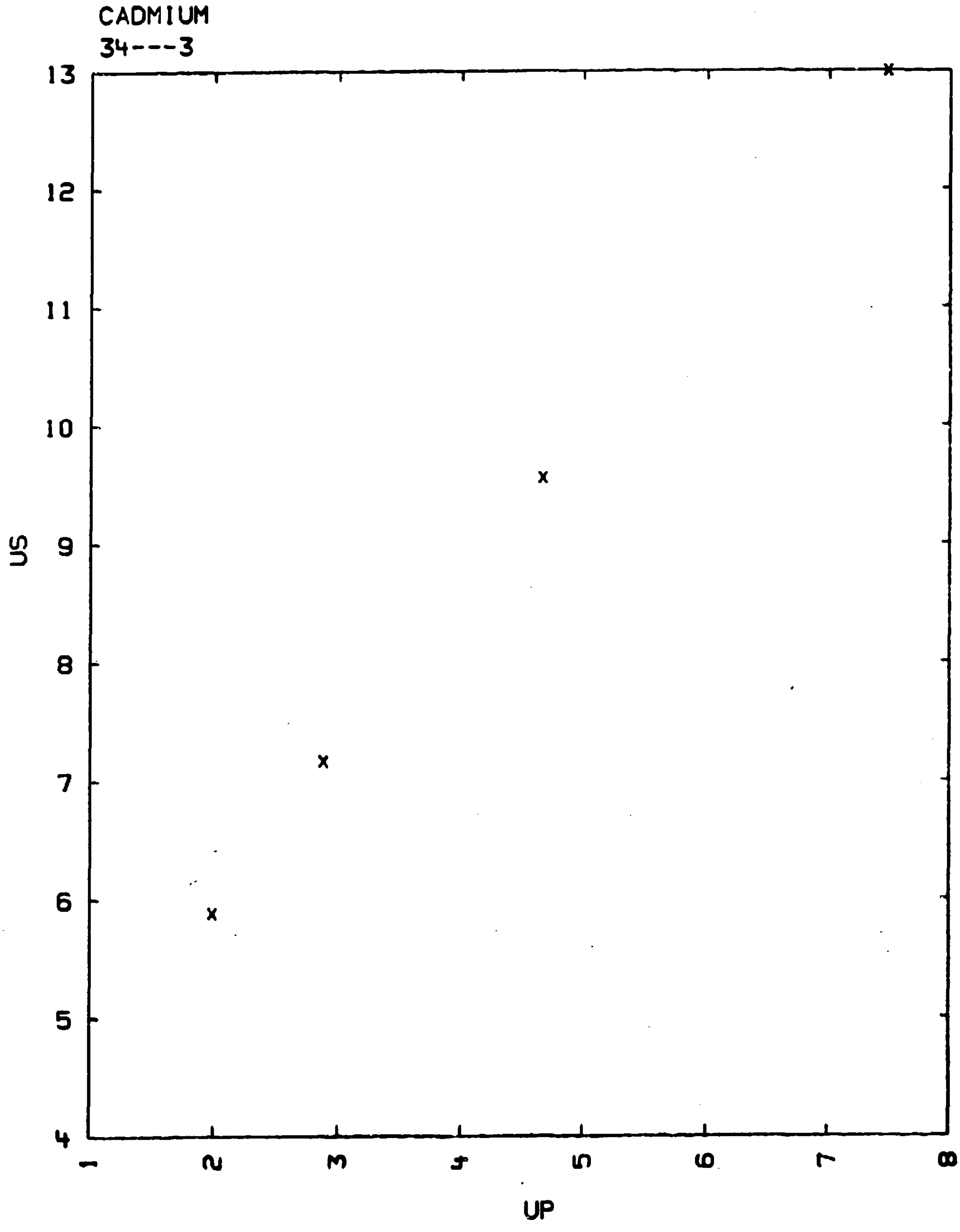


TABLE II



35---1
MERCURY

HG

TO = 17-25 DEG. CENTIGRADE
VO = 0.0739 CC/G   CO = 1.451 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS, DENSITY IN G/CC AND TEMPERATURE IN DEG. CENTIGRADE

TABLE

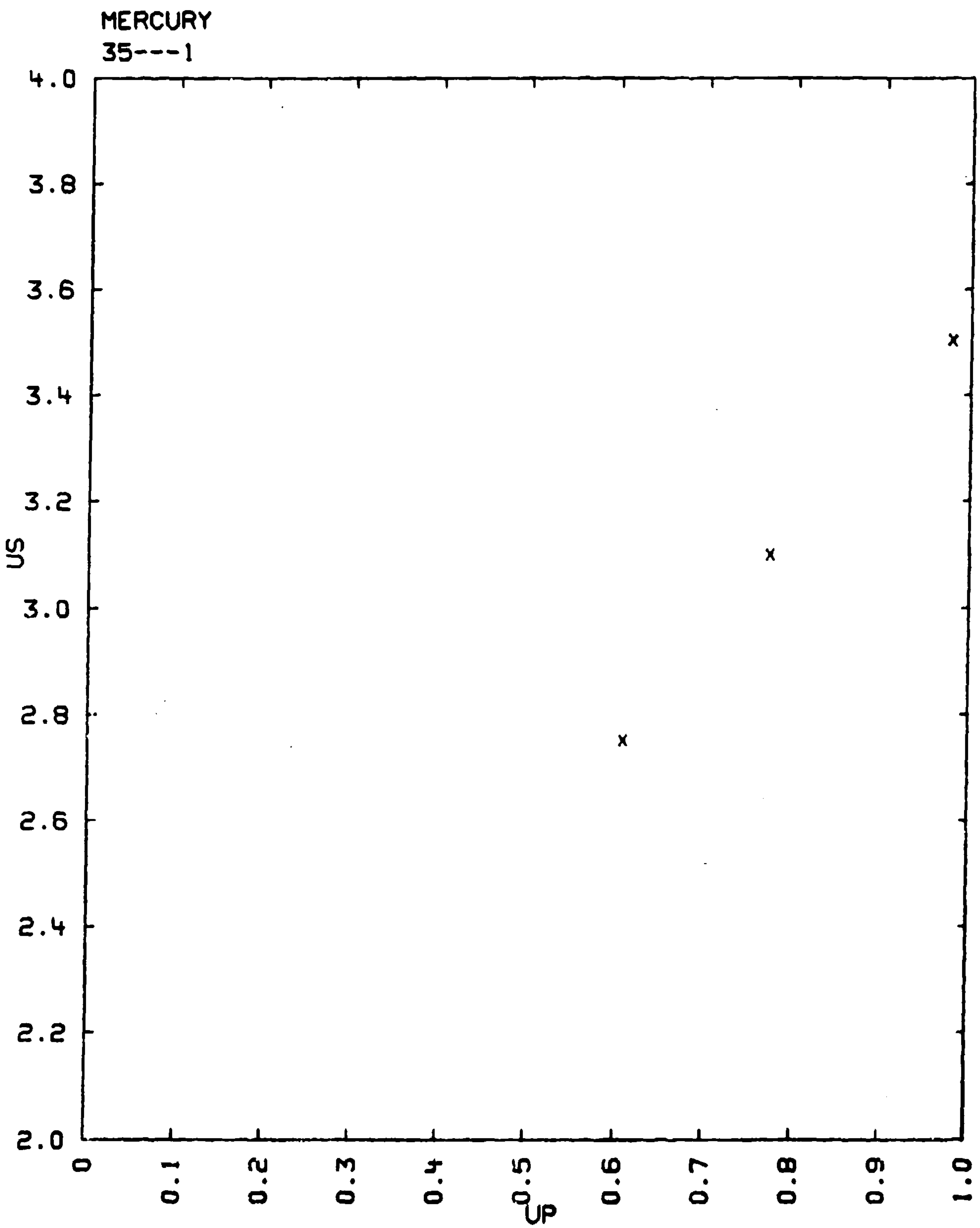
TO	RHOO	US	UP	P	V/VO
25	13.53	2.752	0.608	226.4	0.779
17	-	3.101	0.772	324.0	0.751
24	-	3.504	0.978	463.7	0.721

US = 1.524 + 2.029 UP, SIG.US = 0.013 KM/SEC.

COMMENTS:

1) SOURCE: WALSH J. M. AND RICE M. H.
   JOURNAL OF CHEMICAL PHYSICS, VOL. 26, P. 815 (1957)
2) EXPERIMENTAL TECHNIQUE B
   DATA REDUCTION TECHNIQUE B
   STANDARD MATERIAL 24ST ALUMINUM
3) THE VALUE FOR CO AT 20 DEG. CENTIGRADE WAS OBTAINED FROM THE AMERICAN INSTITUTE OF PHYSICS HANDBOOK, (MCGRAW-HILL BOOK CO., N. Y. 1963) 2ND ED.

TABLE I


MERCURY
35---1
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
US
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP

36---0
COPPER SUMMARY

CU

VO = 0.1120 - 0.448 CC/G
VOI = 0.1119 CC/G

CO = 3.92 KM/SEC.
CB = 3.98 KM/SEC.

THE TABLE LISTS HUGONIOT POINTS CALCULATED FROM THE FIT GIVEN BELOW.
UNITS ARE G/CC, KM/SEC, KILOBARS AND KBAR-CC/G FOR THE ENERGY CHANGE.

TABLE

RHOO	US	UP	P	V/VO	E-EO
8.93	4.740	0.5	212	0.8945	1.25
-	5.473	1.0	489	0.8173	5.
-	6.206	1.5	831	0.758	11.25
-	6.939	2.0	1239	0.712	20.0
-	7.672	2.5	1713	0.674	31.25
-	8.405	3.0	2252	0.643	45.0
-	9.871	4.0	3526	0.595	80.0
-	11.337	5.0	5062	0.559	125.
-	12.803	6.0	6860	0.531	180.
-	14.269	7.0	8920	0.509	245.
5.68	8.515	4.5	2176	0.471	101.
-	9.926	5.5	3101	0.446	151.
-	10.631	6.0	3623	0.436	180.
-	12.041	7.0	4788.	0.419	245.
-	14.862	9.0	7598.	0.394	405.
4.46	8.426	5.0	1879.	0.406	125.
-	9.816	6.0	2626.	0.389	180.
-	11.205	7.0	3498.	0.375	245.
-	12.595	8.0	4493.	0.365	320.
-	14.679	9.5	6219.	0.353	451.
2.96	8.131	5.5	1324.	0.324	151.
-	9.495	6.5	1827.	0.315	211.
-	11.541	8.0	2733.	0.307	320.
-	12.905	9.0	3438.	0.302	405.
2.23	8.325	6.0	1114.	0.279	180.
-	11.028	8.0	1987.	0.274	320.
-	13.731	10.0	3062.	0.272	500.
-	15.758	11.5	4041.	0.270	661.

US = 4.007 - 0.5657*(8.93 - RHOO) + 1.466*UP -
- 0.0171*(8.93 - RHOO)*UP

SIG.US = 0.14
FOR THE LIMITS GIVEN IN THE TABLE.

COMMENTS:

1) SOURCE: COMPILER
1A) THE DATA FROM 36---1,2,3,6 AND 7 WERE USED FOR THE ABOVE FIT.
2) THE POROUS DATA OF PAGE 36---6 AND THE DATA OF 36---2 WERE ASSIGNED A WEIGHT OF 1. THE REST A WEIGHT OF 2 .
3) THE DATA OF 8 AGREES WITH THIS FIT.
4) VOI WAS OBTAINED FROM THE FACE CENTERED CUBIC CELL CONSTANT

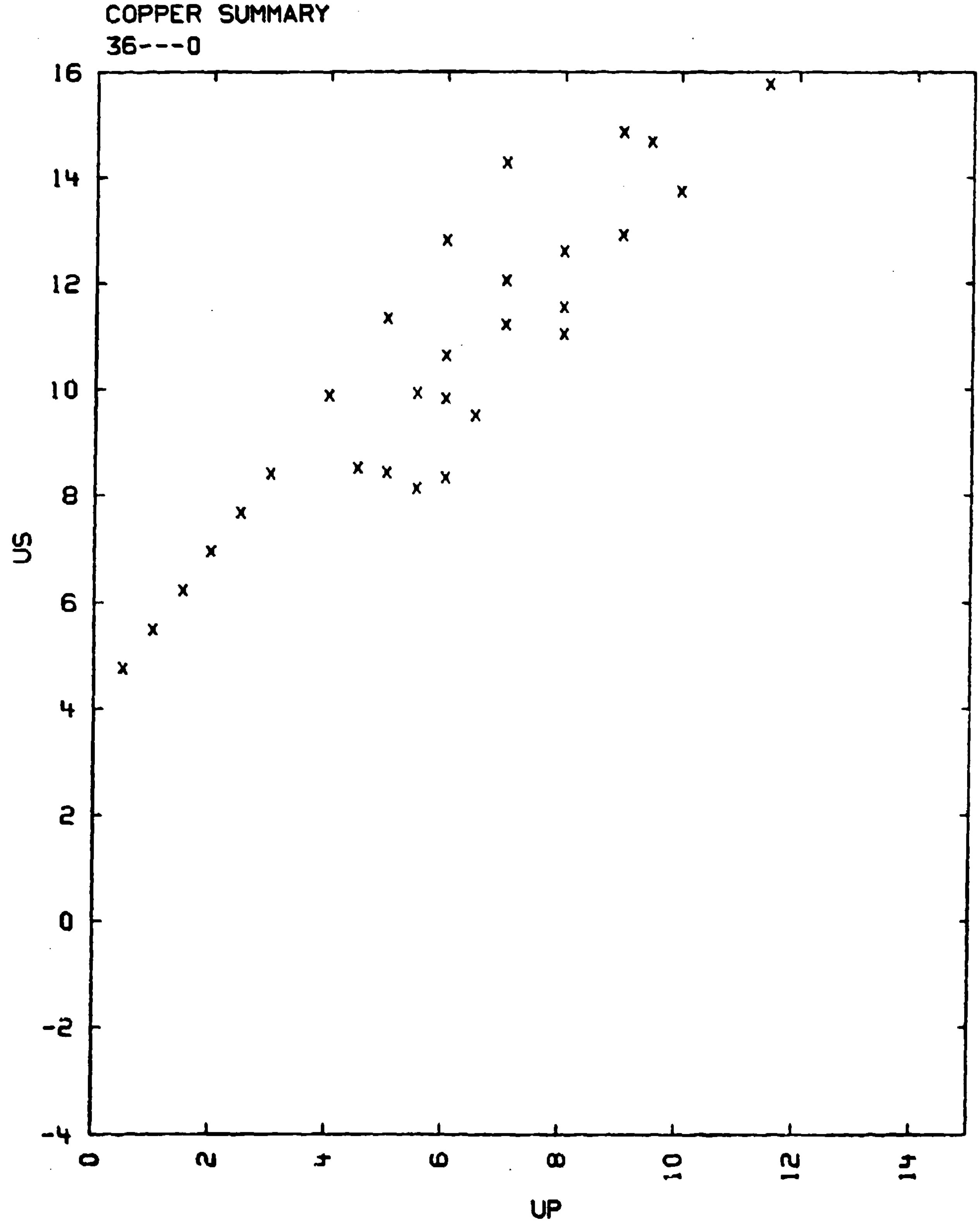
A = 3.61496 ANGSTROM AT 18 DEG. C.

GIVEN BY WYCKOFF, CRYSTAL STRUCTURES, VOL. 1, (INTERSCIENCE PUBL. N. Y. 1963) 2ND. ED.
5) CO WAS CALCULATED FROM THE ELASTIC CONSTANTS OF
6) THE ONSET OF YIELDING OF SINGLE CRYSTALS OF COPPER WAS OBSERVED AT

SHOCK DIRECTION	P1	US1(CALC)	US2
(100)	2.0	4.34	4.22
(110)	1.25	4.97	4.23
(111)	1.25	5.16	4.26

BY O. E. JONES AND J. D. MOTE, J. APPL. PHYS. 40, 4920, (1969)
W. B. DANIELS AND C. S. SMITH, PHYS. REV., VOL. 111, P. 731, (1958).

TABLE I



36---1
COPPER

CU 99.8 PER CENT OR GREATER

VO = 0.1124 CC/G CL = 4.70 KM/SEC. CO = 3.92 KM/SEC.
VOI = 0.1117 CC/G CS = 2.26 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC.
PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

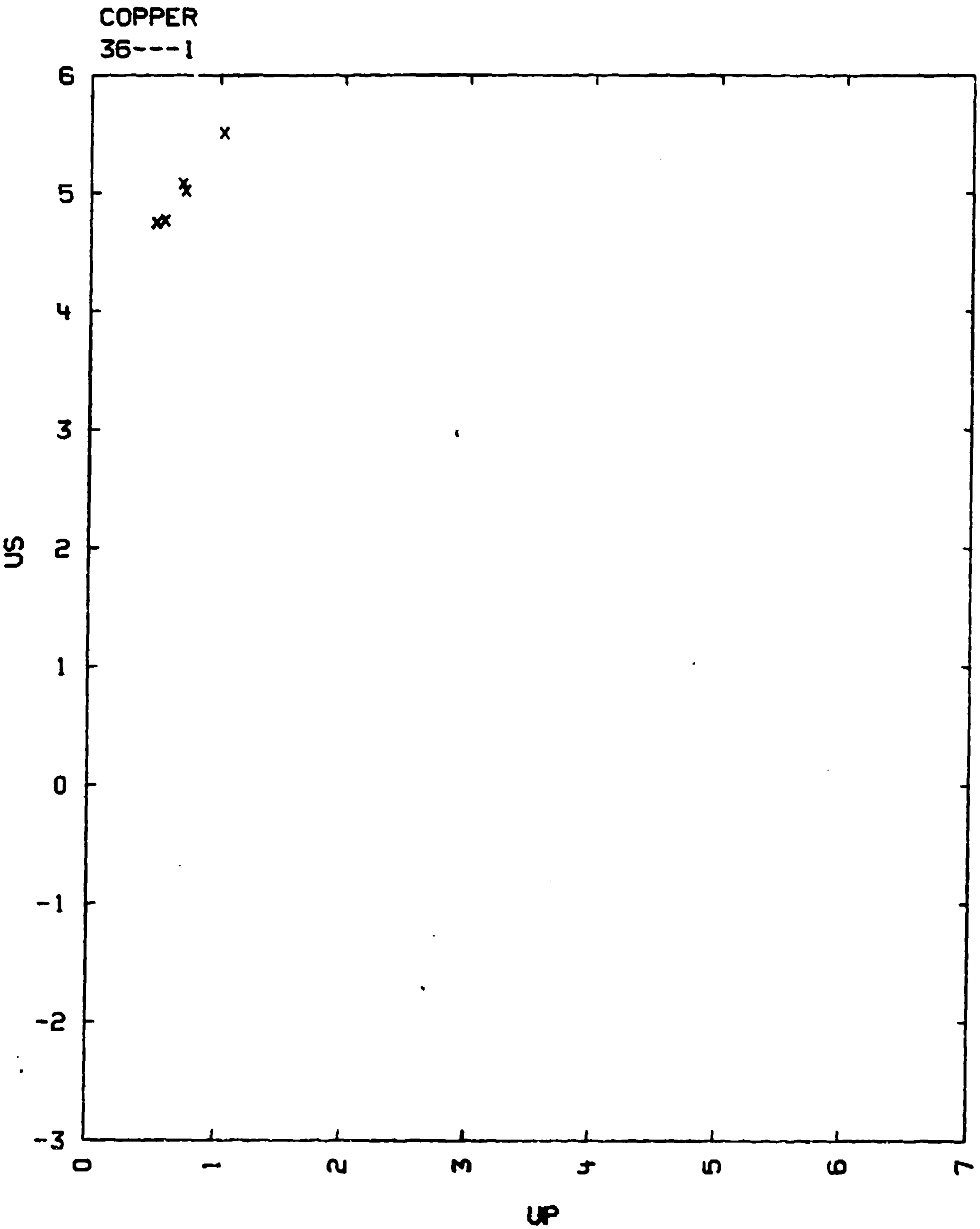
RHOO	US	UFS	UP	P	V/VO
8.90	4.744	1.024	0.511	215.8	0.8923
-	4.768	1.094	0.570	241.9	0.8804
-	5.070	1.440	0.711	320.8	0.8598
-	5.015	1.456	0.731	326.3	0.8542
-	5.508	2.079	1.032	505.9	0.8126

US = 3.944 + 1.514 UP KM/SEC SIGMA US = 0.9 PERCENT

COMMENTS:

1) SOURCE: WALSH, J. M., RICE, M. H., MCQUEEN, R. G. AND YARGER, F. L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS.
4) CL AND CS VALUES WERE OBTAINED FROM L. BERGMAN , DER ULTRASHALL,
S. HIRZEL VERLAG, STUTTGART, 1954, 6TH ED., P. 650
5) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY
FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 1 PER CENT IN
COMPRESSION AT A GIVEN PRESSURE.

TABLE I



38---2
COPPER

CU

V0 = 0.1120 CC/G.
V0I = 0.1121 CC/G.   CB = 3.97 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC.,
PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

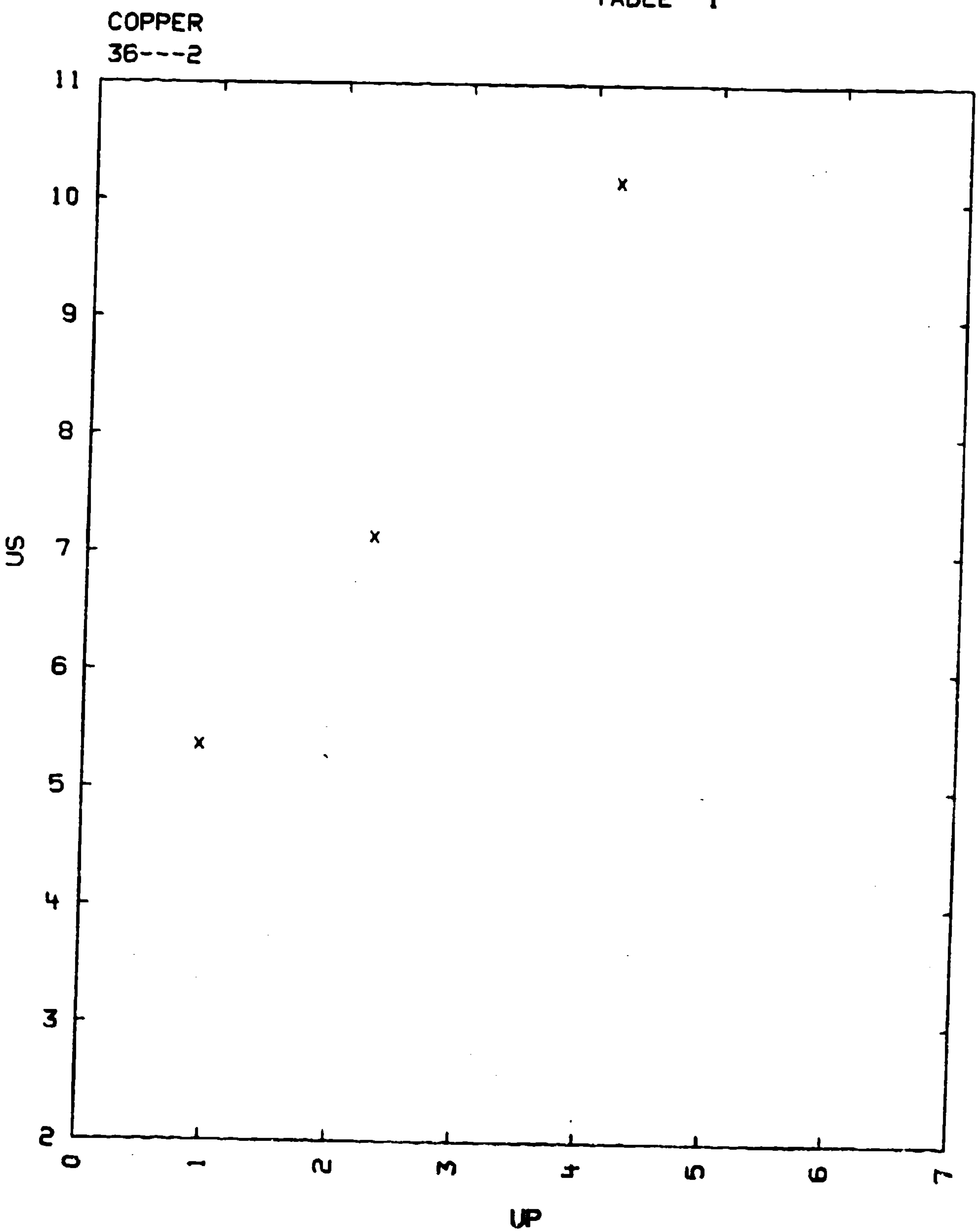
RHOO	US	UP	P	V/VO
8.93	5.36	0.94	450	0.8264
-	7.13	2.29	1460	0.6803
-	10.16	4.19	3800	0.5882

US = 3.90 + 1.46UP KM/SEC.

COMMENTS:

1) SOURCE: AL'TSHULER, L. V., KRUPNIKOV, K. K. AND BRAZHNIK, M. I.
SOVIET PHYS.-JETP, VOL. 34, P. 614 (1958)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL FE.
3) CB IS CALCULATED USING THE VOLUME COMPRESSION COEFFICIENT TAKEN FROM
P. W. BRIDGMAN, THE PHYSICS OF HIGH PRESSURE, (G. BELL AND SONS LTD.
LONDON 1958)
4) V0I WAS TAKEN FROM THE HANDBOOK OF CHEMISTRY AND PHYSICS.
(CHEMICAL RUBBER PUBLISHING CO. CLEVELAND, OHIO 1962-1963) 44TH ED.
5) THE SPECIMEN WITH A THICKNESS BETWEEN 6-8MM. WAS ATTACHED TO AN IRON
PLATE OF COMPARABLE THICKNESS 8-9MM.

TABLE I



36---3
COPPER

CU

V0 = 0.1120 G/CC.
V01 = 0.1119 G/CC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC. ST DESIGNATES THE STANDARD MATERIAL USED AS STRIKER PLATE. U(ST) IS THE STRIKER VELOCITY BEFORE IMPACT.

TABLE

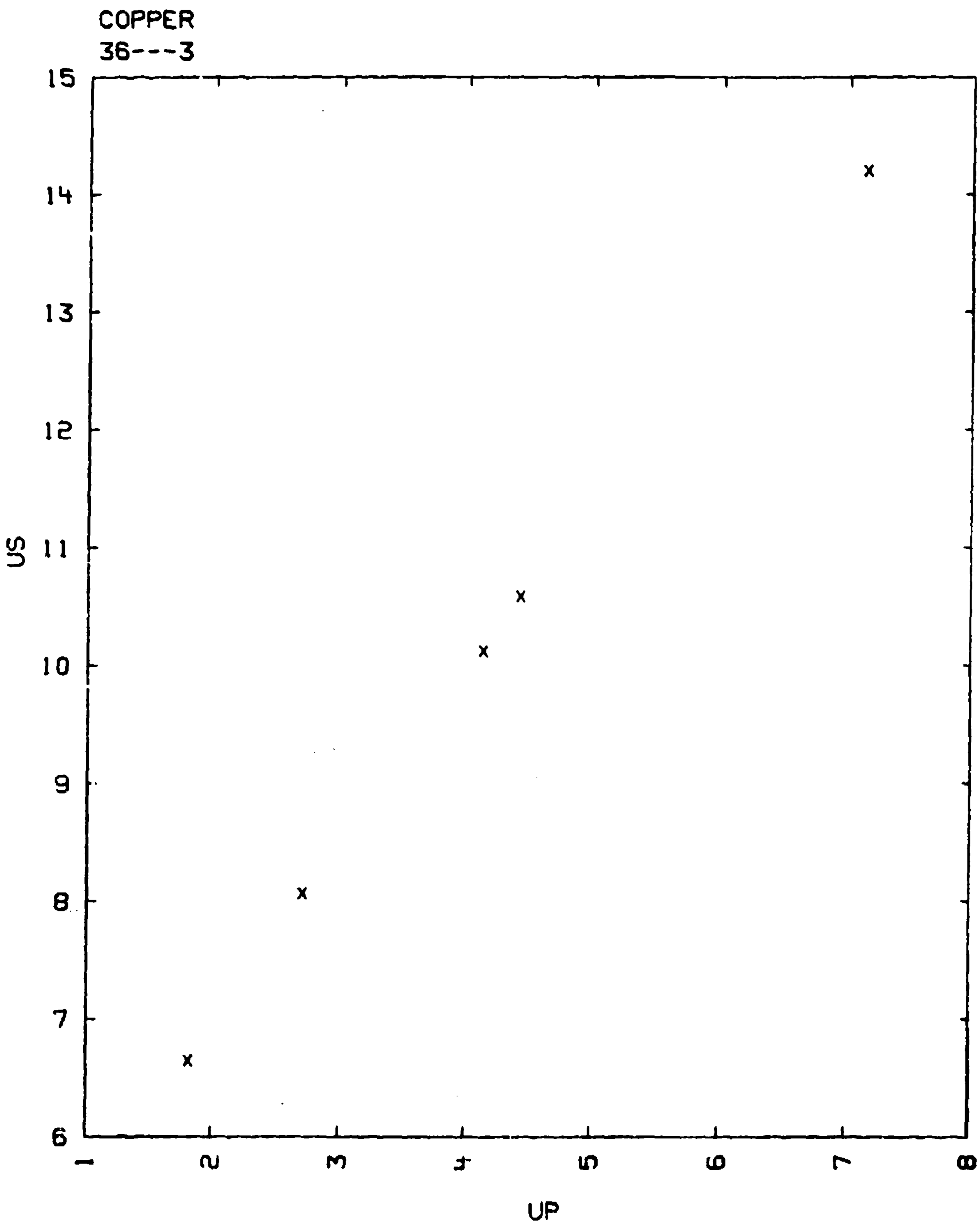
RHO0	US	UP	P	V/V0	ST	U(ST)
8.93	6.64	1.82	1079	0.7262	AL	5.60
-	8.06	2.71	1950	0.6640	FE	5.60
-	10.12	4.14	3740	0.5910	FE	8.64
-	10.58	4.43	4187	0.5814	FE	9.10
-	14.20	7.15	9070	0.4965	FE	14.68

US = 4.20 + 1.41 UP KM/SEC.   FOR UP BETWEEN 1.82 TO7.15 KM/SEC.
SIGMA US = 0.13 KM/SEC.

COMMENTS:

1) SOURCE: AL'TSHULER, L.V., KORMER, S.B., BAKANOVA, A.A.
SOVIET PHYS.-JETP, VOL. 11, PAGE 573 (1960)
AL'TSHULER, L. V. ET AL
SOVIET PHYS.-JETP, VOL. 15, P. 65 (1962)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE A
3) THE PRESSURES WERE PRODUCED BY AN EXPLOSIVELY ACCELERATED ALUMINUM OR STEEL PLATE AS INDICATED IN COLUMN 6.
4) THE INACCURACY IN THE DETERMINATION OF US AND UP FOR PRESSURES TO 4187 KILOBARS DID NOT EXCEED 1.0 PERCENT. EACH POINT IS THE AVERAGE OF 4 TO 6 EXPERIMENTS.
5) THE U UNCERTAINTY OF THE VALUES IN THE LAST TABLE ENTRY ARE: 1 PERCENT IN US OBTAINED FROM 6 TO 8 EXPERIMENTS AND 1.5 PERCENT IN U(ST) OBTAINED FROM 12 EXPERIMENTS.
6) V01 WAS OBTAINED FROM THE AMERICAN INSTITUTE OF PHYSICS HANDBOOK (MCGRAW-HILL BOOK CO., N.Y., 1963) 2ND ED.
THE CORRESPONDING LATTICE PARAMETER FOR THE FACE CENTERED CUBIC LATTICE IS 3.6147 ANGSTROMS

TABLE I



36---4
COPPER

CU

V0 = 0.111 CC/G
V01 = 0.1120 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN KM/SEC, AND PRESSURE IN KILOBARS.

TABLE

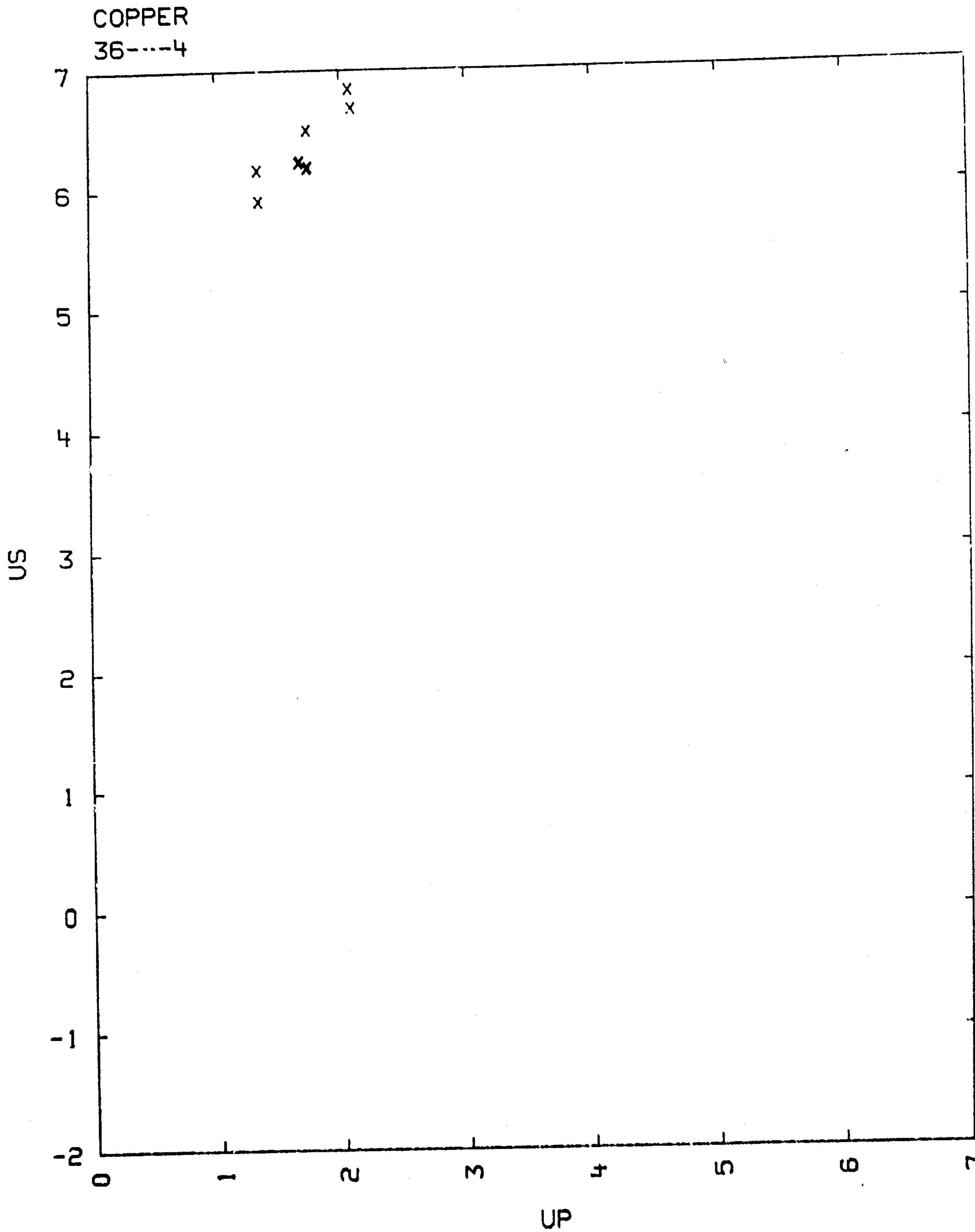
- - - - -	- - -	SAMPLE	- - -	- - -	- - -	PROJECTILE
RHO0	US	UFS	UP	P	V/V0	VELOCITY
8.97	6.68	4.00	2.10	1260	0.686	4.20
-	6.19	3.56	1.76	977	0.717	3.51
-	6.49	3.56	1.75	1018	0.731	3.50
-	6.18	3.57	1.75	970	0.717	3.50
-	6.83	4.18	2.08	1274	0.696	4.16
-	6.16	2.76	1.35	745	0.782	2.69
-	6.22	3.35	1.68	937	0.732	3.35
-	5.90	2.90	1.36	719	0.770	2.72
-	6.23	3.55	1.69	942	0.730	3.37

US = 4.64 + 0.98 UP KM/SEC
SIGMA US = 0.149 KM/SEC

COMMENTS:

1) SOURCE: PERSSON, P. A., PERSSON, I.
FOA 2 REPORT A 2298-222, SEPT. 1964,
FORSVARETS FORSKNINGSANSTALT AVDELNING, SWEDEN
UCRL TRANSLATION 1173(L).
2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION TECHNIQUE B.
3) PRECISION OF VELOCITY MEASUREMENTS PLUS OR MINUS 3 PERCENT.
4) THE PARTICLE VELOCITY UP OF THE SAMPLE WAS TAKEN AS HALF THE PROJECTILE VELOCITY. (COPPER PROJECTILE WAS MOST LIKELY USED).
5) THE VALUE OF V01 WAS OBTAINED FROM A.TAYLOR AND BRENDA J. KAGLE, CRYSTALLOGRAPHIC DATA ON METAL AND ALLOY ST
(DOVER PUBLICATIONS, INC., NEW YORK, N. Y., 1963).

TABLE I



36---5
COPPER

CU

V0 = 0.112 G/CC.
V0I = 0.112 G/CC.

THE TABLES BELOW GIVE THE VELOCITIES OF RELAXATION WAVES, C, AT VARIOUS PRESSURES. THE HUGONIOT STATE THE RELAXATION WAVE TRAVELS THROUGH IS GIVEN BY US, UP, P, OR V/V0. DENSITY IS GIVEN IN G/CC., VELOCITY IN KM/SEC. AND PRESSURE IN KILOBARS. IN TABLE II, ST DESIGNATES THE MATERIAL OF THE STRIKER PLATE, U(ST) IS THE VELOCITY BEFORE IMPACT AND US(ST) IS THE SHOCK VELOCITY IN THE PLATE AFTER IMPACT.

TABLE I

SOUND VELOCITIES
PERPENDICULAR TO SHOCK DIRECTION

RHO0	US	UP	P	V/V0	C
8.93	5.24	0.87	407	0.834	6.33

US =

TABLE II

SOUND VELOCITY
PARALLEL TO SHOCK DIRECTION

---HUGONIOT STATE--------						--DRIVER SYSTEM--		
RHO0	US	UP	P	V/V0	C	ST	U(ST)	US(ST)
8.93	6.69	1.82	1087	0.7278		AL	5.60	10.45
-	5.92	1.31	692	0.7788	6.32	AL	5.60	10.45
-	5.54	1.06	524	0.8084	5.95	AL	5.60	10.45
-	8.11	2.77	2006	0.6583		FE	5.71	8.67
-	7.67	2.47	1692	0.6780	7.78	FE	5.71	8.67
-	7.14	2.12	1352	0.7032	7.13	FE	5.71	8.67
-	6.62	1.77	1046	0.7326	6.71	FE	5.71	8.67
-	10.2	4.18	3796	0.5903	9.48	FE		
-	9.43	3.70	3117	0.6106	8.93	FE		

US =

COMMENTS:

1) SOURCE: AL'TSHULER, L. V., KORMER, S. B., BRAZHNIK, M. I., VLADIMIROV, L. A. AND FUNTIKOV, A. I., SOVIET PHYS.-JETP, VOL.11, P. 766 (1960)
2) EXPERIMENTAL TECHNIQUE A WAS USED IN TABLE II FOR THE FIRST THREE

ENTRIES. FOR ALL OTHER ENTRIES EXPERIMENTAL TECHNIQUE B WAS USED. THE HUGONIOT STATE WAS DETERMINED FROM ONE MEASURED PARAMETER AND THE KNOWN EQUATION OF STATE. AL'TSHULER ET AL, SOVIET PHYS-JETP, VOL. 11, P. 573 (1960).

3) THE SOUND VELOCITY IN TABLE I WAS OBTAINED FROM THE SHAPE OF THE FREE SURFACE AFTER IT HAD MOVED SOME DISTANCE. IN TABLE II THE SOUND VELOCITY WAS DETERMINED FROM THE ATTENUATION IN THE MEASURED SHOCK OR FREE SURFACE VELOCITY PRODUCED BY THE RAREFACTION WAVE ORIGINATING AT THE REAR SURFACE OF THE STRIKER PLATE.

4) V01 WAS OBTAINED FROM THE HANDBOOK OF CHEMISTRY AND PHYSICS (THE CHEMICAL RUBBER PUBLISHING CO., CLEVELAND, OHIO 1962-1963) 44TH ED.

5) THE MEASURED SOUND VELOCITY IS HIGHER THAN THE CALCULATED SOUND VELOCITY FOR A PURELY NONELASTIC SAMPLE

TABLE I

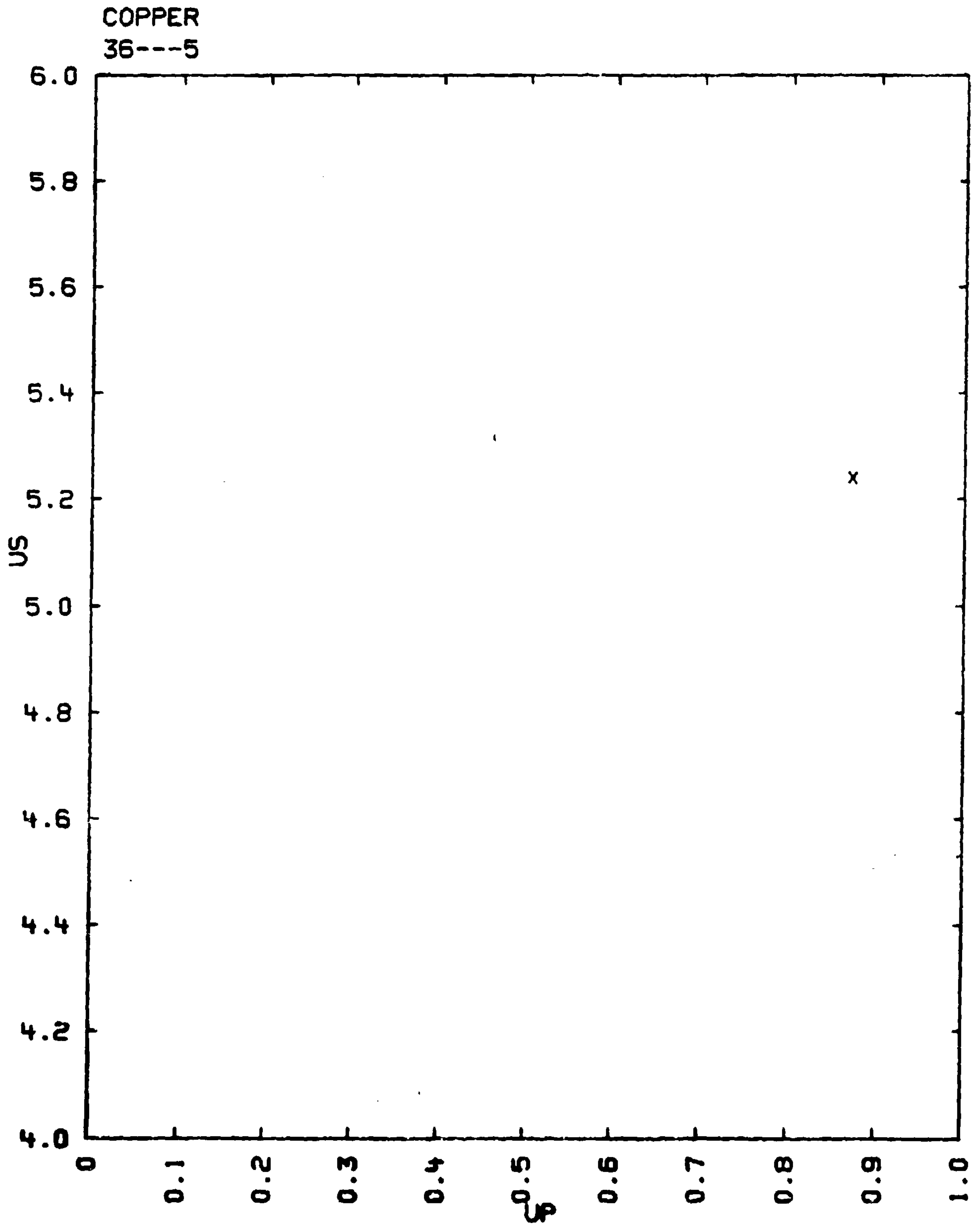
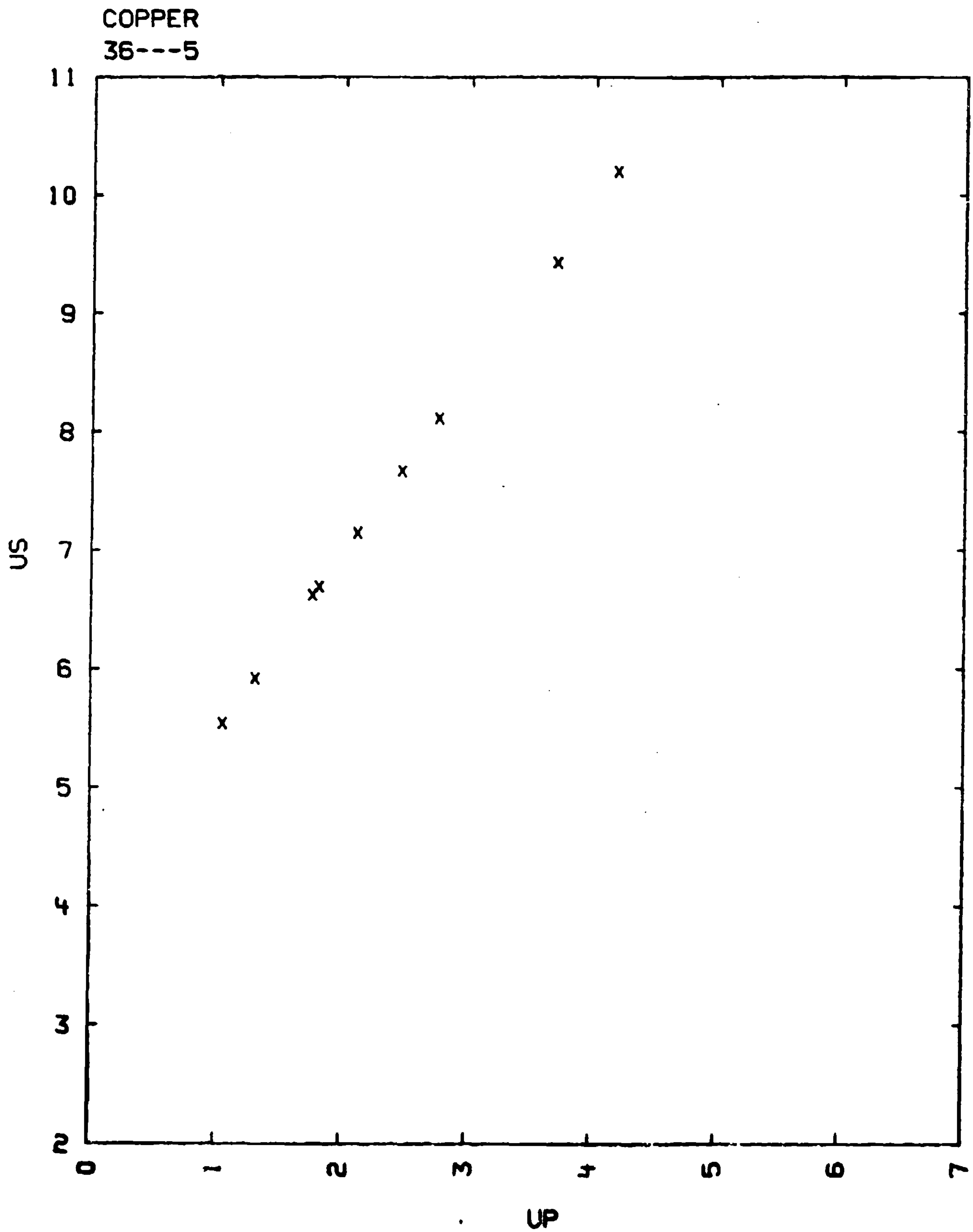

COPPER
36---5
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
US
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP
x

TABLE II



36---6
COPPER POROUS

CU 99.7 PERCENT
AVERAGE GRAIN SIZE IS 5 MICRONS.

VOI = 0.112 CC/G.
VO = 1/RHOO SEE TABLE

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURES IN KILOBARS AND DENSITY IN G/CC. ST DESIGNATES THE STANDARD MATERIAL AND THE MATERIAL OF THE STRIKER PLATE. U(ST) IS THE STRIKER VELOCITY BEFORE IMPACT. SH LABELS THE HUGONIOT VARIABLES OF THE IRON SAMPLE HOLDER AFTER IMPACT.

TABLE

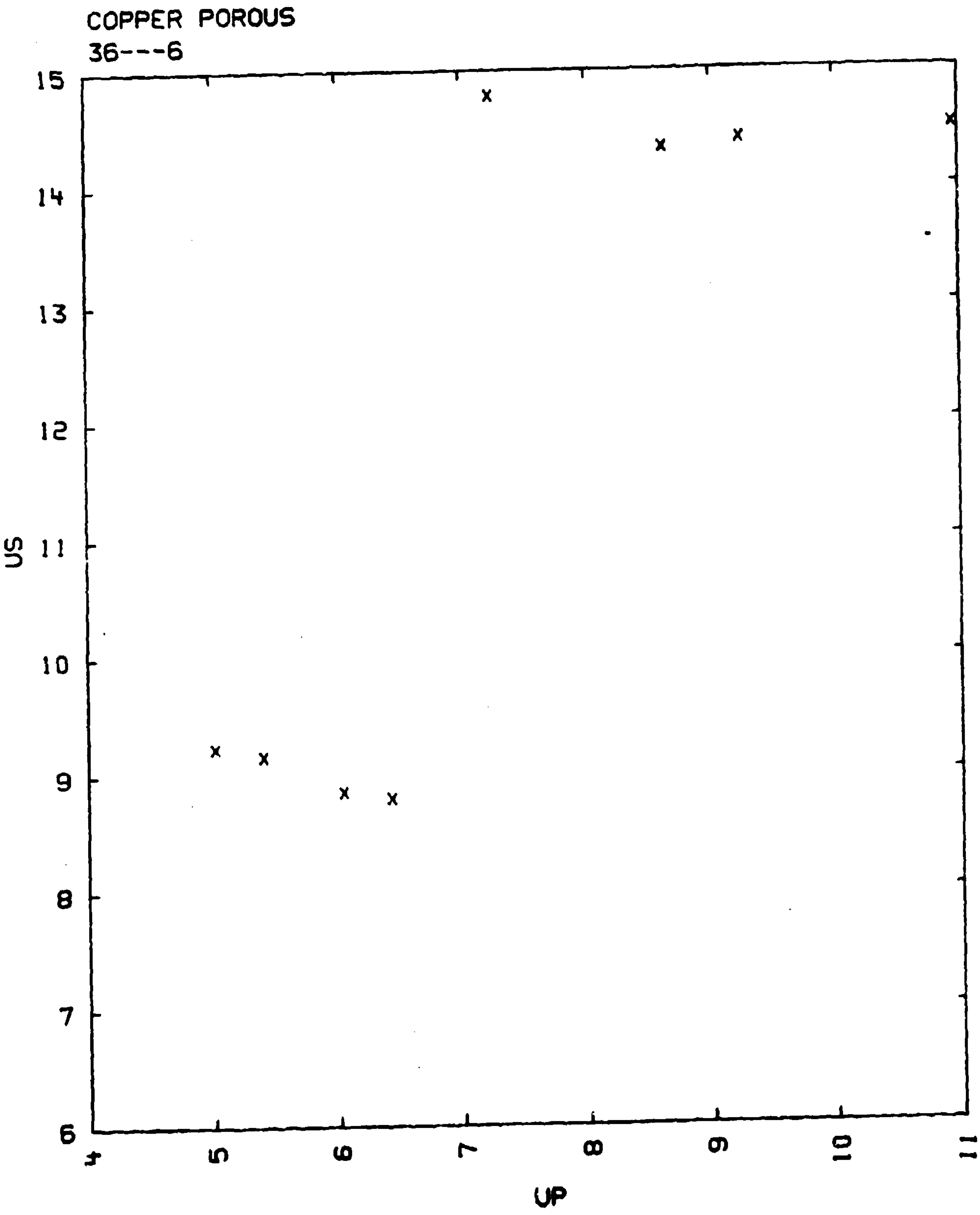
--------SAMPLE--------						----DRIVER SYSTEM----		
RHOO	US	SIGMA US	UP	P	V/VOI	U(ST)	US(ST)	UP(ST)
5.68	9.22	0.04	5.01	2626	0.7168	8.64	10.67	4.26
4.46	9.15	0.07	5.40	2204	0.8203	8.64	10.67	4.26
2.96	8.85	0.07	6.04	1582	0.9569	8.64	10.67	4.26
2.23	8.79	0.03	6.43	1260	1.079	8.64	10.67	4.26
8.92	14.78	0.16	7.24	9550	0.5102	15.45		
5.68	14.32	0.34	8.62	7010	0.6270	15.45		
4.46	14.39	0.12	9.24	5950	0.7133	15.45		
2.23	14.50	0.14	10.95	3540	0.9823	15.5		

US =

COMMENTS:

1) SOURCE: KORMER, S. B., FUNTIKOV, A. I., URLIN, V. D. AND KOLESNIKOVA, A. N.
SOVIET PHYS.-JETP, VOL. 15, P. 477 (1962)
2) EXPERIMENTAL TECHNIQUE A. (STANDARD MATERIAL IRON).
DATA REDUCTION TECHNIQUE B.(FIRST FOUR ENTRIES) AND A (OTHER ENTRIES)
3) US IS THE AVERAGE DETERMINATION TAKEN FROM 4-8 EXPERIMENTS, EACH CONSISTING OF 4-6 READINGS.
4) VOI WAS OBTAINED FROM THE HANDBOOK OF CHEMISTRY AND PHYSICS (THE CHEMICAL RUBBER PUBLISHING CO., CLEVELAND, OHIO 1962-1963) 44TH ED.

TABLE I



36---7
COPPER

CU

VO = .112 G/CC.
VOI = .112 G/CC. CB = 3.98 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURES IN KILOBARS AND DENSITY IN G/CC.

TABLE

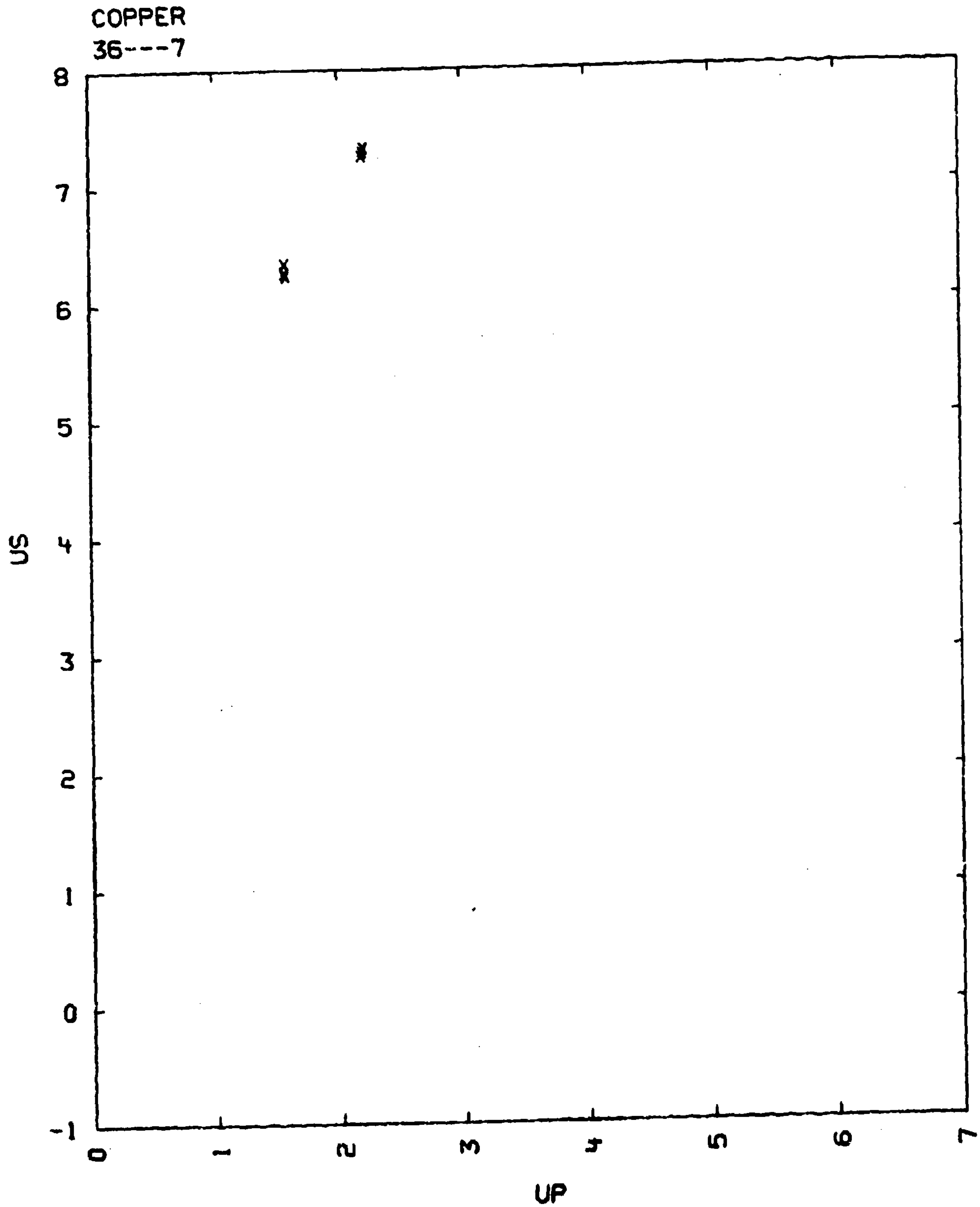
-SAMPLE-					-STANDARD-
RHOO	US	UP	P	V/VO	P(ST)
8.90	6.33	1.57	883	0.752	842
-	6.23	1.58	875	0.746	842
-	6.26	1.57	877	0.749	842
-	7.26	2.20	1424	0.697	1362
-	7.29	2.21	1430	0.698	1366
-	7.32	2.22	1444	0.697	1378

US = 3.958 + 1.497 UP SIGMA US = 0.42 PERCENT

COMMENTS:

1) SOURCE: MCQUEEN, R. G. AND MARSH S. P.
JOURNAL OF APPLIED PHYSICS, VOL. 31, P. 1253, (1960)
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS BRASS
3) VOI WAS OBTAINED FROM THE HANDBOOK OF CHEMISTRY AND PHYSICS (THE CHEMICAL RUBBER PUBLISHING CO., CLEVELAND, OHIO 1962-1963) 44TH ED.

TABLE I



36---8
COPPER

CU

VO = 0.112
VOI = 0.1120 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

RHOO	US	UFS	UP	P	V/VO
8.93	7.150	4.710	2.290	1460	0.680
-	7.120	4.590	2.23	1420	0.686
-	7.540	5.020	2.43	1640	0.677
-	6.925	4.340	2.12	1310	0.696
-	7.235	4.780	2.32	1510	0.679
-	6.790	4.165	2.035	1230	0.700
-	7.240	4.55	2.215	1430	0.694
-	7.090	4.53	2.210	1400	0.689
-	7.225	4.75	2.310	1490	0.681
-	6.830	4.01	1.960	1190	0.713
-	6.640	3.62	1.780	1060	0.731
-	6.490	3.52	1.730	1000	0.733
-	7.160	4.51	2.195	1400	0.694
-	6.910	4.13	2.020	1240	0.708
-	6.700	3.90	1.910	1140	0.714
-	6.44	3.64	1.790	1030	0.721
-	6.88	3.95	1.930	1190	0.719
-	6.79	4.09	2.00	1210	0.706
-	6.66	3.515	1.73	1020	0.740
-	6.62	3.65	1.795	1060	0.729
-	6.845	4.20	2.05	1250	0.700
-	7.230	4.805	2.33	1505	0.677
-	7.260	4.750	2.31	1500	0.682
-	7.050	4.48	2.18	1370	0.690
-	6.890	4.37	2.13	1310	0.691
-	6.85	4.13	2.02	1235	0.705
-	6.86	4.07	1.99	1220	0.710
-	6.91	4.27	2.08	1290	0.699
-	6.775	3.70	1.82	1100	0.732
-	6.75	3.74	1.835	1110	0.728
-	6.68	3.78	1.85	1110	0.723
-	6.54	3.87	1.90	1110	0.709
-	6.555	3.525	1.73	1010	0.736
-	6.50	3.49	1.71	990	0.737
-	6.52	3.54	1.74	1010	0.734
-	6.26	3.46	1.70	950	0.728
-	6.20	2.95	1.46	810	0.764
-	6.27	3.21	1.53	860	0.756
-	6.50	3.70	1.815	1050	0.720
-	6.55	3.71	1.820	1060	0.722
-	6.39	3.50	1.720	980	0.731

COPPER

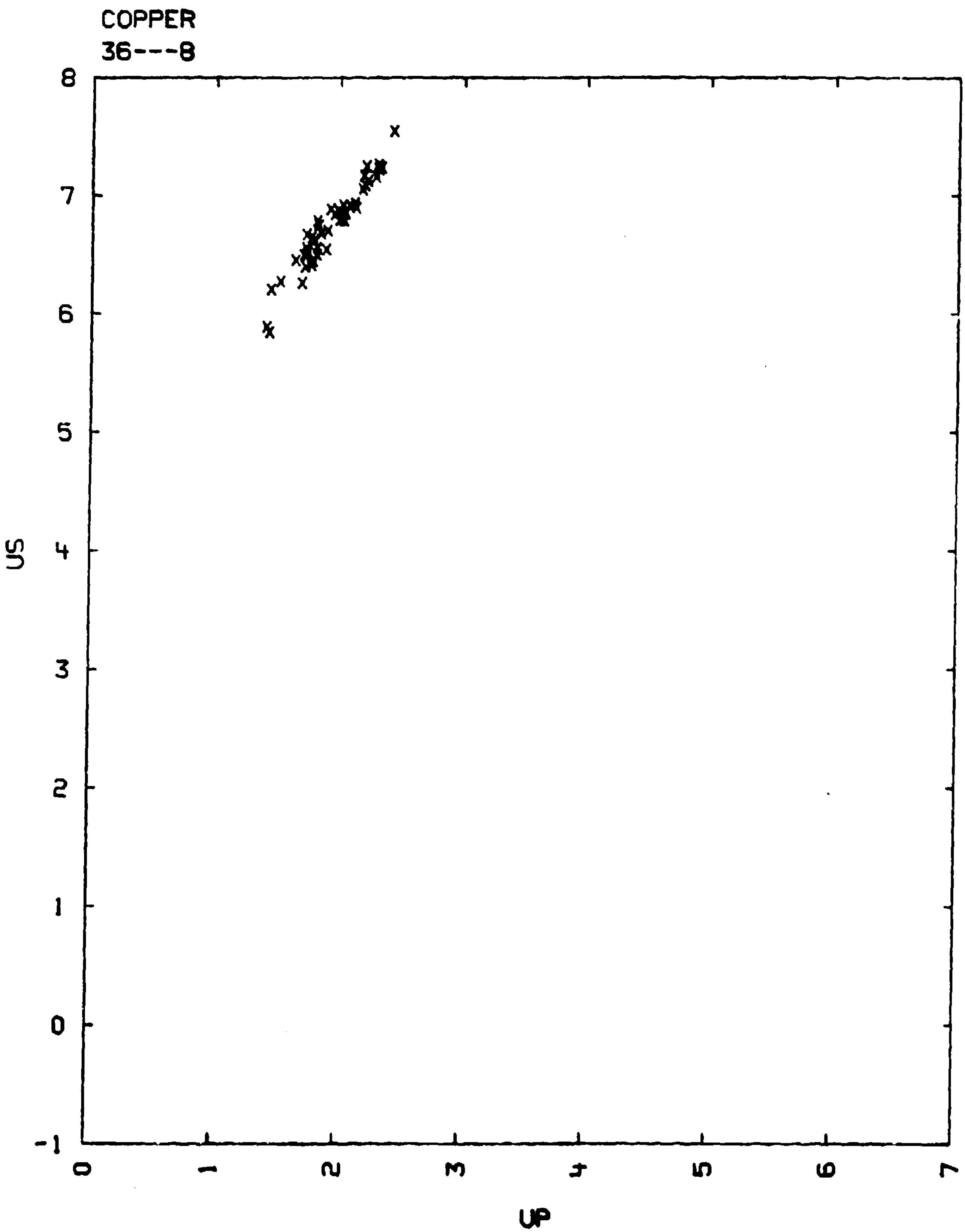
RHOO	US	UFS	UP	P	V/VO
-	6.445	3.34	1.646	950	0.744
-	6.40	3.615	1.78	1010	0.722
-	5.88	2.870	1.42	740	0.759
-	5.84	2.910	1.44	750	0.753

US = 4.12 + 1.81 UP, SIG.US = 0.15 KM/SEC.

COMMENTS:

1) SOURCE: BERGER, J. AND FAUQUIGNON, B.P.
PRIVATE COMMUNICATION (1964), B.P. NO. 7, SEVRAN, FRANCE
2) EXPERIMENTAL TECHNIQUES A AND B
DATA REDUCTION TECHNIQUE
STANDARD MATERIAL
3) VOI WAS DETERMINED FROM THE AMERICAN INSTITUTE OF PHYSICS HANDBOOK (MCGRAW-HILL BOOK CO., N.Y., 1963) 2ND ED.
THE CORRESPONDING LATTICE PARAMETER FOR THE FACE CENTER CUBIC LATTICE IS 3.6147 ANGSTROMS.
4) SAMPLE DIMENSIONS FOR THE US MEASUREMENTS: 2.0 CM DIAMETER
0.5 CM THICKNESS
SAMPLE DIMENSIONS FOR THE UFS MEASUREMENTS: 2.0 CM DIAMETER
0.25 CM THICKNESS

TABLE I



36---9
COPPER

PB,FE,SI,ZN,AG AND OTHERS LESS THAN 0.052 WT PERCENT
CU REMAINDER - -

VO = 0.1119 CC/G CO = 3.894 KM/SEC
VOI= 0.1119 CC/G

THE TABLE LISTS ALL THE PRESSURES AND COMPRESSIONS OF THE MULTIPLE WAVE SYSTEMS USED IN THE DATA ANALYSIS OF THESE RELATIVELY BROAD SHOCK WAVES, TOGETHER WITH THE HYDROSTATIC PRESSURE (PH) AND THE APPROXIMATE USI AND UPI VALUES CALCULATED FROM THEM. DENSITY IS IN G/CC, VELOCITIES IN KM/SEC AND PRESSURE (PH) OR STRESS (PI) IN KBARS. NO = EXPERIMENT NUMBER I INDICATES THE 1ST 2ND 3RD ETC. WAVE OF THE SYSTEM. U = PROJECTILE VELOCITY AND MAT = PROJECTILE MATERIAL.

TABLE

U	RHOO	USI	UPI	PI	VI/VO	I	PH	MAT
0.0315	8.939	4.5	0.0013	0.54	0.9997	1		CU
	-	4.0	0.0053	1.96	0.9987	2		
	-	3.9	0.0134	4.79	0.9966	3		
	-	3.8	0.0161	5.70	0.9959	4	5.65	
0.0374	-	4.9	0.0029	1.29	0.9994	1		-
	-	3.9	0.0274	9.78	0.9931	2		
	-	3.4	0.0287	10.19	0.9927	3	10.09	
0.1223	-	4.5	0.0018	0.74	0.9996	1		-
	-	4.1	0.0582	21.05	0.9856	2		
	-	3.5	0.0607	21.82	0.9849	3	21.62	
0.1735	-	4.6	0.0018	0.75	0.9996	1		-
	-	4.13	0.0823	29.86	0.9797	2	29.68	
0.2440	-	4.4	0.0022	0.89	0.9995	1		-
	-	4.20	0.0931	34.33	0.9774	2		
	-	4.03	0.118	43.35	0.9711	3	43.14	
0.2995	-	4.4	0.0013	0.52	0.9997	1		-
	-	4.2	0.0349	12.99	0.9916	2		
	-	4.19	0.144	52.92	0.9648	3	52.69	
0.5852	-	4.43	0.292	115.95	0.9340	1	115.83	-

US = (FOR SHOCK VELOCITY FIT, SEE COMMENT 3)

COMMENTS:

1) SOURCE: MUNSON, D. E. AND BARKER, L. M.
J. APPL. PHYS., VOL. 37, P. 1652, (1966)

SANDIA CORPORATION, ALBUQUERQUE, NEW MEXICO

2) EXPERIMENTAL TECHNIQUE F AND AN INTERFERROMETRIC METHOD.
DATA REDUCTION METHOD D WITH 2UP = UFS
WITH THE MODIFICATION THAT A SMOOTH BROAD WAVE
WAS APPROXIMATED BY A SET OF DISCREET PRESSURE STEPS. THE SHOCK VELOCITY MEASUREMENTS WERE CORRECTED FOR ERRORS INTRODUCED BY SURFACE INTERACTIONS.

3) NOTE THAT USI AND UPI ARE ONLY APPROXIMATE NUMBERS CALCULATED FROM THE PI AND VI/VO VALUES. IN THE FIT BELOW US IS OBTAINED FROM THE VALUE OF PH OF A PARTICULAR WAVE SYSTEM AND THE CORRESPONDING VALUE OF VI USING THE EQUALITY US = VO[PH/(VO-VI)]**1/2, WHILE UP WAS TAKEN TO BE 1/2 THE MAXIMUM FREE SURFACE VELOCITY. THESE POINTS ARE COMBINED WITH DATA FROM LOS ALAMOS TO GIVE:

US = 3.917 + 1.520*UP KM/SEC.   UP FROM 0 TO 2.2 KM/SEC

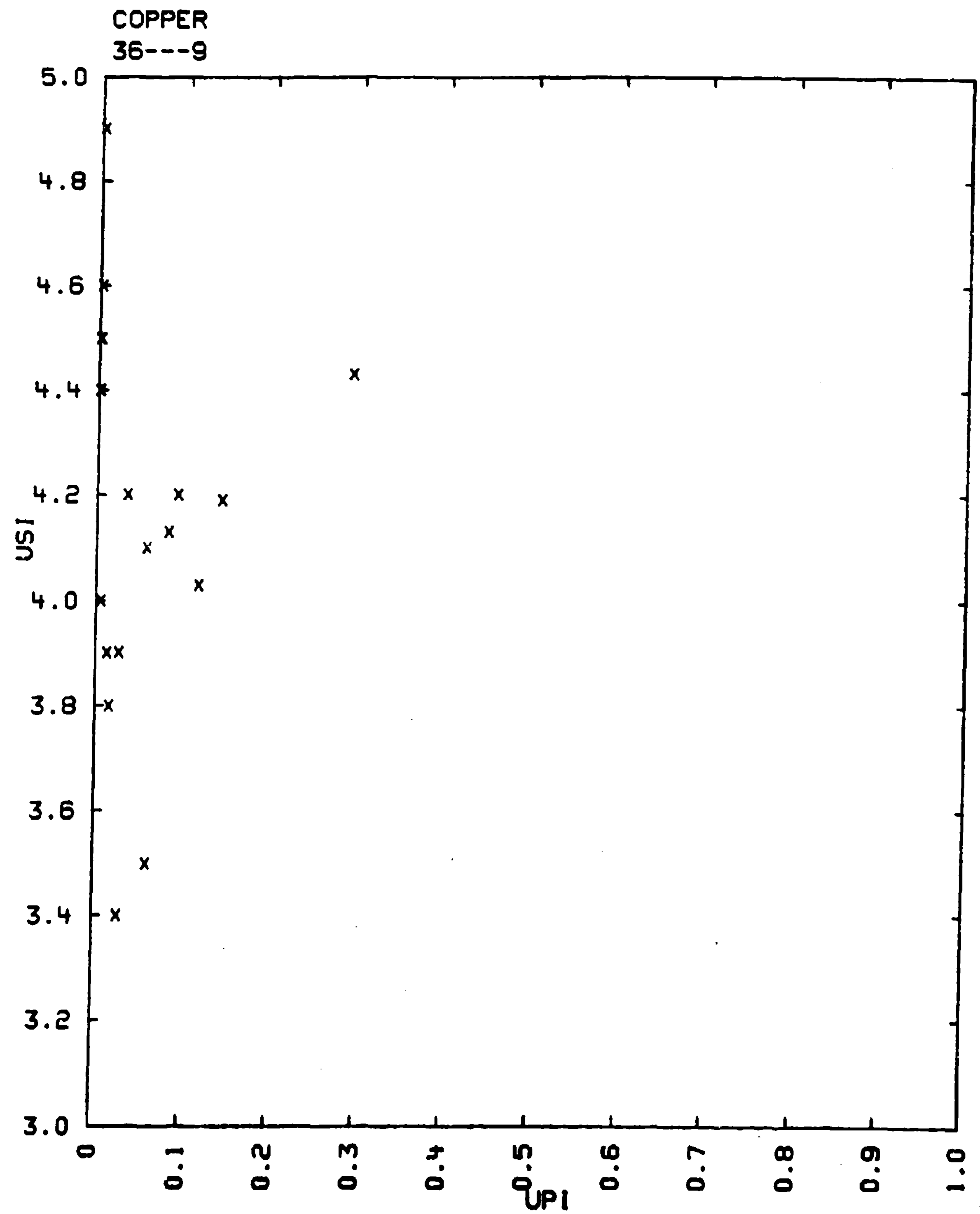
INCLUDING AL'TSHULER 1960 DATA UP TO UP = 4.45 KM/SEC YIELDS

US = 3.927 + 1.507*UP KM/SEC. MAX. DEV. IS 1.4 PERCENT

4) PH = PI - 2/3*Y, WHERE THE YIELD POINT Y IS A FUNCTION OF THE DEGREE OF WORK HARDENING.

5) VOI WAS CALCULATED FROM THE CUBIC UNIT CELL CONSTANT GIVEN IN WYCKOFF, CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, 1963) A= 3.61496 ANGSTROM AT 18 DEG. CENTIGRADE

TABLE I


COPPER
36---9
USI
UPI
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

38---10
COPPER POROUS

CA SI FE NI SN ZN	0.2	MOLE PERCENT	(0.05 IN SOLID SAMPLES)
C	0.01-0.1	- -	
O	0.26	- -	(0.05 - - -)
CU	REST		
PARTICLE SIZE	5. TO 20 MICRONS		

V0 = 0.1118 - 0.158 CC/G
V0I= 0.1119 CC/G

THE TABLE LISTS DENSITY IN G/CC, VELOCITIES IN KM/SEC AND PRESSURES IN KBAR. SEE COMMENT 7

TABLE I

RHO0	US1	UP1	P1	V1/V0	US2	UP2	P2	V2/V0
8.94	4.61	0.010	4.3	0.998	4.13	0.089	33.2	0.979
-	4.48	0.010	4.2	0.998	4.06	0.084	30.9	0.980
-	4.68	0.008	3.2	0.999	4.28	0.224	85.9	0.948
-					4.38	0.324	126.8	0.927

US = .386 + 2.8*UP KM/SEC
SIG US = .24 KM/SEC

TABLE II

RHO0	US1	UP1	P1	V1/V0	US2	UP2	P2	V2/V0
6.62	2.80	0.007	1.4	0.997	1.56	0.387	40.4	0.754
6.42	2.6	0.007	1.2	0.997	1.29	0.224	19.1	0.828
6.45	3.00	0.010	2.0	0.997	0.59	0.15	7.	0.75
6.72	2.	0.007	1.	0.996	0.59	0.13	6.	0.79
6.34	2.90	0.008	1.5	0.997	0.77	0.22	12.	0.72
6.40	2.93	0.004	0.7	0.999	1.78	0.491	56.1	0.725
6.56	3.23	0.002	0.6	0.999	1.78	0.492	57.6	0.724
6.31	3.09	0.004	0.8	0.999	1.43	0.401	36.6	0.720
6.82	3.03	0.005	1.0	0.998	1.50	0.205	21.4	0.865
6.84	2.4	0.009	1.4	0.996	0.55	0.09	4.	0.85
6.36	2.81	0.004	0.8	0.999	1.60	0.498	51.0	0.691

US =

COMMENTS:

1) SOURCE: SCHMIDT, D.N. AND LINDE, R.K.
AIR FORCE WEAPONS LAB. REP.: CONTRACT NO. AF 29(601)-7236
SRI PROJECT: PGU-6127
STANFORD RES. INST., MENLO PARK, CALIFORNIA, U. S. A.

2) EXPERIMENTAL TECHNIQUE: 11 AND 12

DATA REDUCTION TECHNIQUE: C. WAVE PROFILES WERE BROAD BUT WERE APROXIMATED BY A STEP FUNCTION MOVING AT THE AVERAGE WAVE VELOCITY LISTED

3) THE FOOT OF THE ELASTIC WAVE IS BETWEEN 1 AND 10 PERCENT FASTER THAN THE AVERAGE VELOCITY LISTED. THE PROFILE AND AVERAGE VELOCITY OF THE PLASTIC (CRUSHING) WAVE WAS INFERRED FROM THE STRESS-TIME PROFILE AT THE GUAGE-SAMPLE INTERFACE AND THE REVERBERATION TIME OF AN ELASTIC RELEASE WAVE REFLECTING OF THE CRUSHING WAVE.

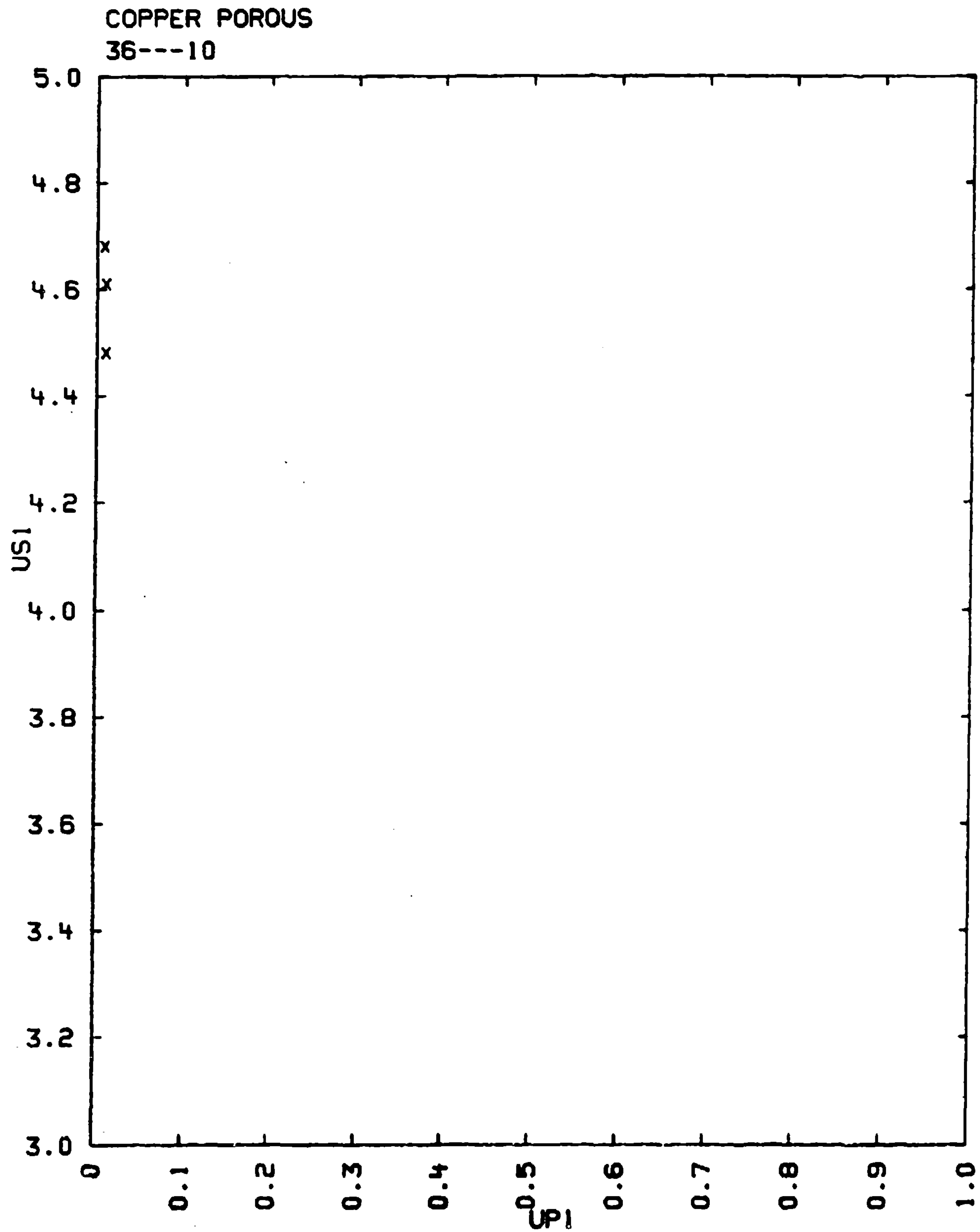
4) THE LAST SAMPLE LISTED, WITH A RHOO VALUE OF 6.36 G/CC WAS HEATED AT 1100 DEG. F. IN A HYDROGEN ATMOSPHERE TO REMOVE OXIDE AND VOLATILE ORGANIC MATERIALS. THIS YIELDED A COMPRESSION CONSISTENT WITH ALL EXCEPT THE FOUR SAMPLES WITH RHOO = 6.62 6.42 6.31 AND 6.82. THESE WERE CONSIDERABLY LESS COMPRESSIBLE, SUGGESTING A HIGHER IMPURITY LEVEL.

5) ALL POROUS SAMPLES WERE COMPACTED AND SINTERED AT 1700 DEG. F.

6) V0I WAS OBTAINED FROM WYCKOFF, CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, 1963). CUBIC CELL CONSTANT = 3.61496 ANGSTROM.

7) NOTE THAT THE SECOND WAVE PARAMETERS IN THE TABLE REPRESENT A CRUSHING CURVE. P IS AN EFFECTIVE LONGITUDINAL STRESS OBTAINED BY CONSIDERING THE SAMPLE AS A HOMOGENEOUS ISOTROPIC MEDIUM.

TABLE I



COPPER POROUS
36---10
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
US1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP1

TABLE II

COPPER POROUS
36---10

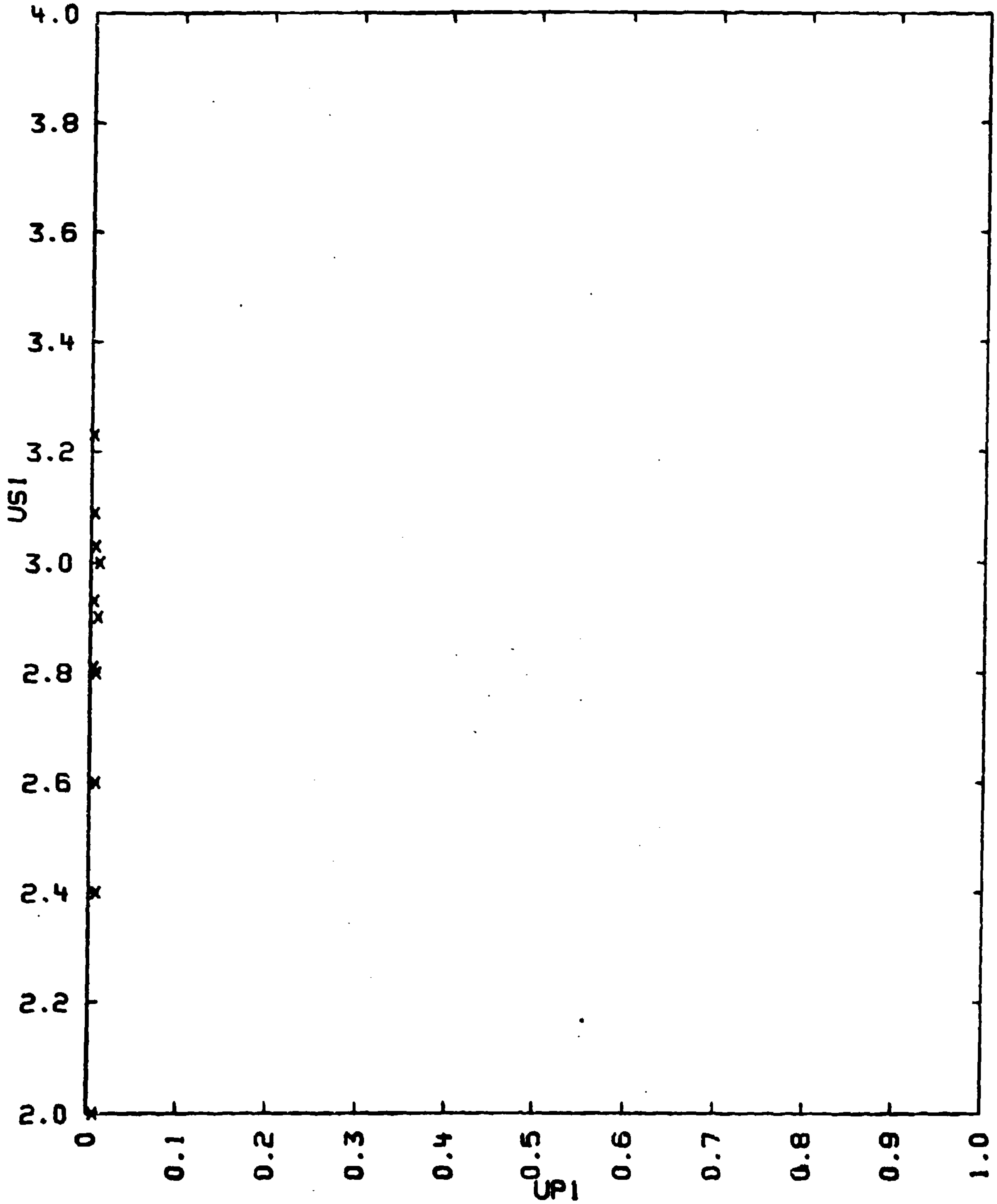


TABLE I

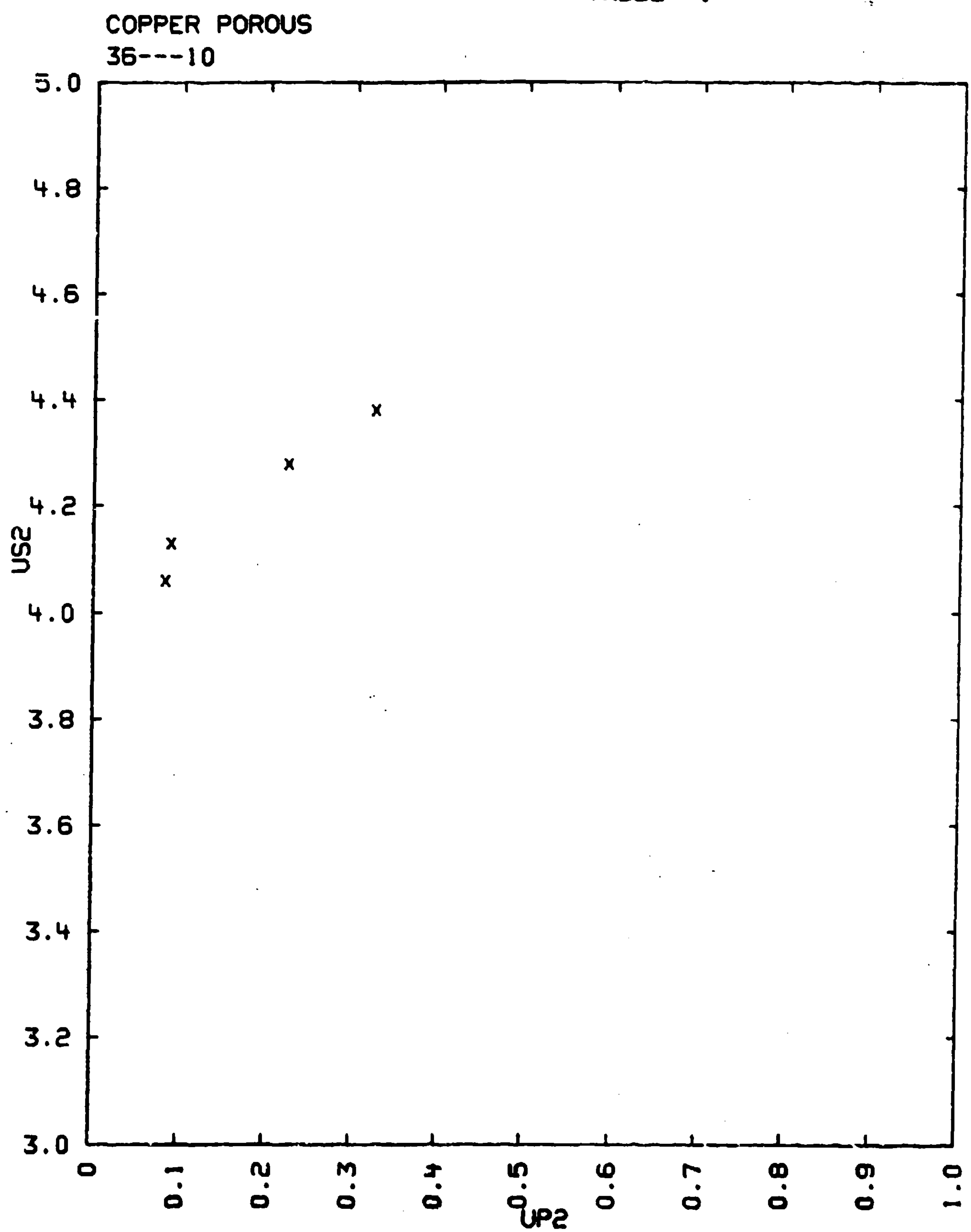
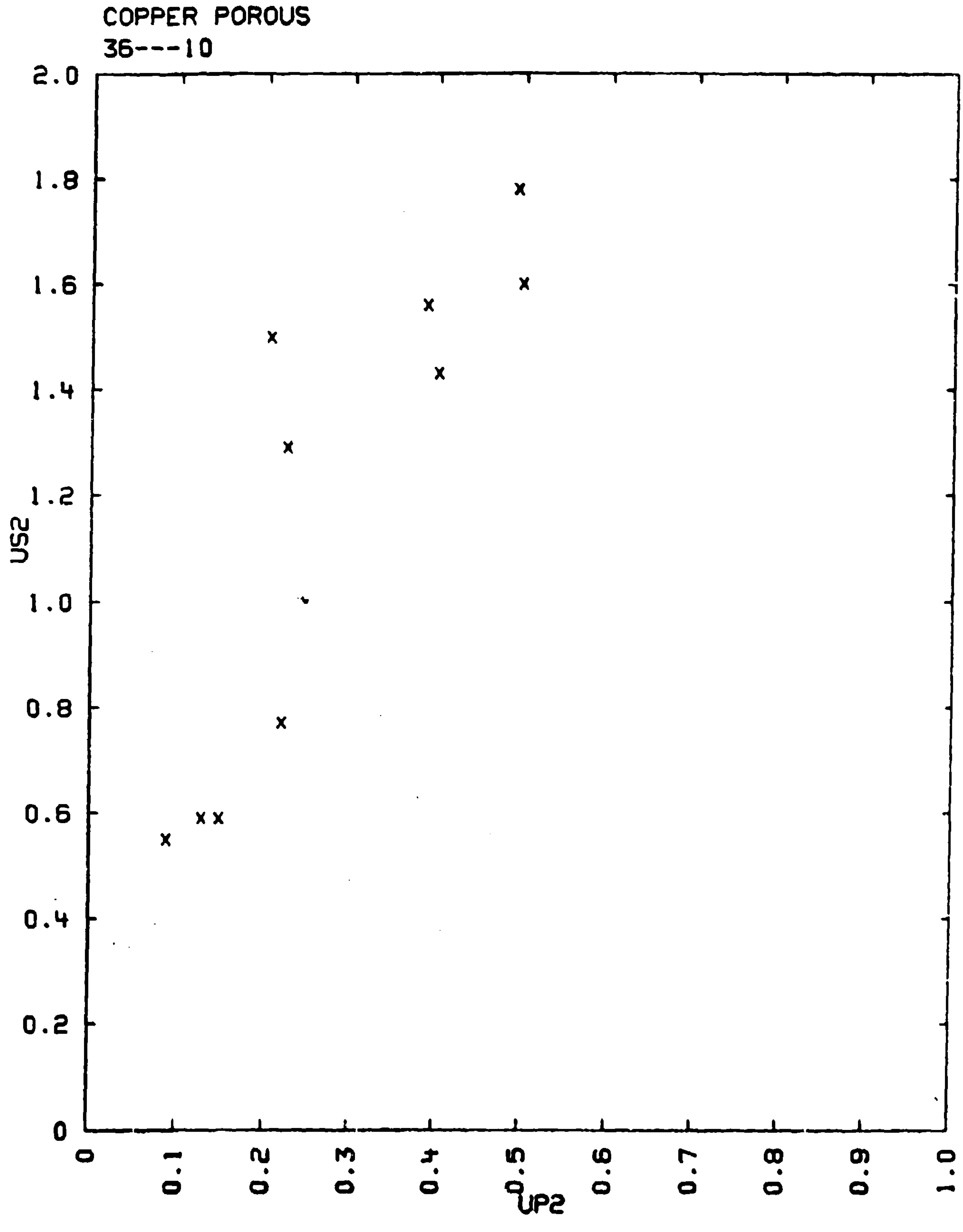

COPPER POROUS
36---10
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
US2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP2

TABLE II


COPPER POROUS
36---10
US2
UP2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

38---11
COPPER, OFHC

FE	.0005	WT. PERCENT
S	.0025	- -
AG	.0010	- -
NI	.0006	- -
SB	.0005	- -
PB	.0006	- -
CU	REST	

V0 =0.1120 CC/G   CL= 4.757 KM/SEC   C0 = 3.99 KM/SEC
CS= 2.247 KM/SEC

THE TABLE LISTS RHO0 IN G/CC, VELOCITIES IN KM/SEC AND P IN KBARS. CU= COPPER, FS= FANSTEEL, AL= ALUMINUM AND WF= WEIGHTING FACTOR.

TABLE

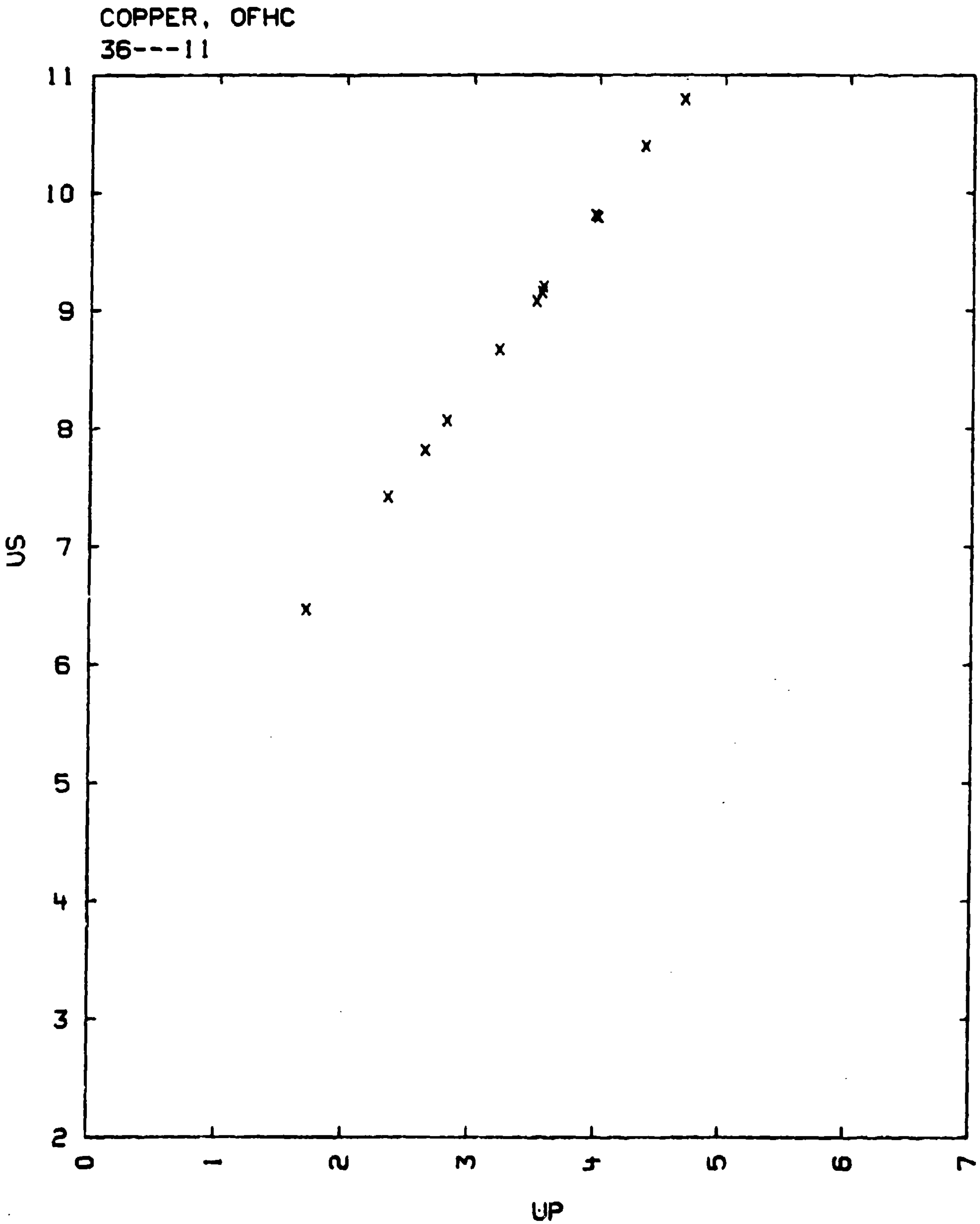
SAMPLE					IMPACTOR		
RHO0	US	UP	P	V/V0	MAT	U	WF
8.930	6.463	1.713	989.	.7350	CU	3.426	3
8.930	7.414	2.343	1551.	.6840	FS	3.875	3
8.930	7.815	2.631	1836.	.6633	AL	7.929	1
8.930	8.062	2.808	2022.	.6517	FS	4.673	3
8.930	8.669	3.217	2490.	.6289	CU	6.434	3
8.930	9.076	3.509	2843.	.6134	CU	7.018	3
8.930	9.149	3.549	2900.	.6121	CU	7.097	1
8.930	9.196	3.561	2924.	.6128	CU	7.121	1
8.930	9.785	3.988	3485.	.5924	FS	6.728	1
8.930	9.802	3.971	3476.	.5949	CU	7.937	1
8.930	10.390	4.368	4053.	.5796	FS	7.405	1
8.930	10.785	4.674	4502.	.5666	FS	7.932	1

US = 3.984 + 1.463*UP KM/SEC
SIG.US= 0.009 KM/SEC

COMMENTS:

1) SOURCE: ISBELL W.M., SHIPMAN F.H. AND JONES A.H.
HUGONIOT EQUATION OF STATE OF ELEVEN MATERIALS TO FIVE MBARS
MATERIALS SCIENCE LABORATORY REPORT: MSL-68-13
2) EXPERIMENTAL TECHNIQUE: A
DATA REDUCTION METHOD : A
3) NOMINAL UNCERTAINTIES ARE: (SIG.US)/US = .005 AND (SIG.U)/U = .0005
4) POISSON RATIO = 0.356

TABLE I



38---12
COPPER

CU

VO = 0.1120-0.225 CC/G   CL = 4.76 KM/SEC   CO = 3.93 KM/SEC
VOI = 0.1119   CS = 2.33 KM/SEC

IN THE TABLES BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBAR AND DENSITY IN G/CC. STANDARD MATERIAL DESCRIBES THE IMPACTOR.

TABLE I

SAMPLE					STANDARD
RHOO	US	UP	P	V/VO	MATERIAL
8.930	4.48	0.41	164.	0.9085	COPPER
8.931	4.57	0.41	167.	0.9103	COPPER
8.928	4.89	0.62	271.	0.8732	COPPER
8.930	4.91	0.64	281.	0.8697	COPPER
8.930	4.91	0.73	320.	0.8513	COPPER
8.930	5.07	0.74	335.	0.8540	COPPER
8.930	4.89	0.74	323.	0.8487	COPPDR
8.930	5.18	0.85	393.	0.8359	COPPER
8.930	5.36	0.95	455.	0.8228	COPPER
8.930	5.84	1.25	652.	0.7860	COPPER
8.930	6.19	1.48	818.	0.7609	COPPER
8.930	6.51	1.71	994.	0.7373	COPPER
8.928	6.55	1.74	1018.	0.7344	COPPER
8.930	6.91	1.99	1228.	0.7120	COPPER
8.930	6.88	2.04	1253.	0.7035	COPPER
8.930	7.03	2.10	1318.	0.7013	COPPER
8.928	7.46	2.37	1578.	0.6823	COPPER
8.930	7.47	2.37	1581.	0.6827	COPPER

US = 3.940 + 1.489*UP KM/SEC HUGONIOT FIT ADOPTED BY THE SOURCE
COMPARISON LEAST SQUARE FITS:
US = A0 + A1*UP KM/SEC
A0 3.912 KM/SEC   SIG A0 = 0.030 KM/SEC
A1 = 1.498 -   SIG A1 = 0.021 -
SIG US = 0.059 -

TABLE II

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
8.920	4.31	0.21	81.	0.9513	2024 AL	5.79
8.925	4.21	0.21	79.	0.9501	2024 AL	5.79
8.900	4.22	0.22	83.	0.9479	2024 AL	5.81
8.928	4.34	0.28	108.	0.9355	2024 AL	5.84

U08/14/77

RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
8.925	4.35	0.28	109.	0.9356	2024 AL	5.94
8.920	4.32	0.29	112.	0.9329	2024 AL	5.95
8.920	4.35	0.29	113.	0.9333	2024 AL	5.96
8.925	4.38	0.30	117.	0.9315	2024 AL	5.98
8.930	4.30	0.30	115.	0.9302	2024 AL	5.98
8.925	4.51	0.39	157.	0.9135	2024 AL	6.18
8.928	4.50	0.40	161.	0.9111	2024 AL	6.18
8.933	4.47	0.43	172.	0.9038	2024 AL	6.25
8.933	4.50	0.44	177.	0.9022	2024 AL	6.26
8.900	4.71	0.49	205.	0.8960	2024 AL	6.38
8.900	4.69	0.49	205.	0.8955	2024 AL	6.38
8.899	4.71	0.52	218.	0.8896	2024 AL	6.44
8.924	4.73	0.52	219.	0.8901	2024 AL	6.45
8.925	4.80	0.53	227.	0.8896	2024 AL	6.47
8.920	4.75	0.53	225.	0.8884	2024 AL	6.48
8.925	4.70	0.54	227.	0.8851	2024 AL	6.47
8.900	4.71	0.55	231.	0.8832	2024 AL	6.49
8.930	4.77	0.56	239.	0.8826	2024 AL	6.53
8.918	4.71	0.58	244.	0.8769	2024 AL	6.55
8.933	4.85	0.66	286.	0.8639	2024 AL	6.72
8.900	5.01	0.69	308.	0.8623	2024 AL	6.79
8.900	4.95	0.71	313.	0.8566	2024 AL	6.82
8.918	5.04	0.73	328.	0.8552	2024 AL	6.87
8.924	5.06	0.75	339.	0.8518	2024 AL	6.91
8.930	4.94	0.76	335.	0.8462	2024 AL	6.91
8.933	5.07	0.79	358.	0.8442	2024 AL	6.98
8.933	5.19	0.80	371.	0.8459	2024 AL	7.03
8.933	5.18	0.81	375.	0.8436	2024 AL	7.04
8.933	5.22	0.83	387.	0.8410	2024 AL	7.09
8.933	5.15	0.87	400.	0.8311	2024 AL	7.14
8.933	5.33	0.94	448.	0.8236	2024 AL	7.30
8.933	5.33	0.94	448.	0.8236	2024 AL	7.31
8.899	5.44	0.99	479.	0.8180	2024 AL	7.41
8.900	5.44	1.01	489.	0.8143	2024 AL	7.43
8.918	5.51	1.03	506.	0.8131	2024 AL	7.48
8.924	5.50	1.06	520.	0.8073	2024 AL	7.54
8.930	5.53	1.06	523.	0.8083	2024 AL	7.55
8.930	6.03	1.39	748.	0.7695	2024 AL	8.21
8.930	6.02	1.40	753.	0.7674	2024 AL	8.21
8.924	5.98	1.40	747.	0.7659	2024 AL	8.21
8.918	6.92	2.00	1234.	0.7110	2024 AL	9.40
8.918	7.23	2.17	1399.	0.6999	2024 AL	9.74
8.929	7.17	2.21	1415.	0.6918	2024 AL	9.79
8.924	7.65	2.41	1645.	0.6850	2024 AL	10.23
8.924	7.60	2.46	1668.	0.6763	2024 AL	10.29
8.924	7.73	2.56	1766.	0.6688	2024 AL	10.47

US = A0 + A1*UP KM/SEC

A0 = 3.910 KM/SEC SIG A0 = 0.012 KM/SEC

A1 = 1.510 - SIG A1 = 0.011 -

SIG US = 0.049 -

TABLE III

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
8.930	4.32	0.31	120.	0.9282	921-T AL	5.76
8.925	4.53	0.41	166.	0.9095	921-T AL	5.98
8.925	4.49	0.41	164.	0.9087	921-T AL	5.98
8.930	4.76	0.62	264.	0.8697	921-T AL	6.43
8.925	5.08	0.79	358.	0.8445	921-T AL	6.80
8.925	5.07	0.79	357.	0.8442	921-T AL	6.80
8.930	5.05	0.82	370.	0.8376	921-T AL	6.86
8.930	5.05	0.82	370.	0.8376	921-T AL	6.86
8.925	5.58	1.11	553.	0.8011	921-T AL	7.48
8.925	5.53	1.12	553.	0.7975	921-T AL	7.48
8.930	5.53	1.13	558.	0.7957	921-T AL	7.52
8.928	6.12	1.46	798.	0.7614	921-T AL	8.21
8.928	6.08	1.47	798.	0.7582	921-T AL	8.21
8.928	6.56	1.78	1043.	0.7287	921-T AL	8.84
8.928	6.56	1.78	1043.	0.7287	921-T AL	8.84
8.928	7.24	2.16	1396.	0.7017	921-T AL	9.65
8.928	7.14	2.18	1390.	0.6947	921-T AL	9.65
8.928	7.67	2.48	1698.	0.6767	921-T AL	10.26
8.928	7.65	2.48	1694.	0.6758	921-T AL	10.26

US = A0 + A1*UP KM/SEC
A0 = 3.836 KM/SEC
A1 = 1.539 -

SIG A0 = 0.021 KM/SEC
SIG A1 = 0.014 -
SIG US = 0.041 -

TABLE IV

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
8.930	5.01	0.68	304.	0.8643	FE	4.93
8.930	4.99	0.68	303.	0.8637	FE	4.93
8.930	5.47	0.98	479.	0.8208	FE	5.49
8.930	5.47	0.98	479.	0.8208	FE	5.49
8.930	6.31	1.57	885.	0.7512	FE	6.53
8.930	6.87	1.94	1190.	0.7176	FE	7.15
8.930	6.84	1.94	1186.	0.7164	FE	7.15
8.929	7.59	2.39	1620.	0.6851	FE	7.90
8.929	7.65	2.42	1653.	0.6837	FE	7.96
8.929	7.68	2.48	1701.	0.6771	FE	8.05
8.929	7.65	2.49	1701.	0.6745	FE	8.05
8.929	8.23	2.78	2043.	0.6622	FE	8.54
8.929	8.17	2.79	2035.	0.6585	FE	8.54
8.929	8.16	2.79	2033.	0.6581	FE	8.54
8.929	8.14	2.81	2042.	0.6548	FE	8.56
8.929	8.10	2.82	2040.	0.6519	FE	8.56
8.929	8.09	2.82	2037.	0.6514	FE	8.56
8.929	8.08	2.82	2035.	0.6510	FE	8.56
8.929	8.41	2.92	2193.	0.6528	FE	8.75
8.929	8.35	2.93	2185.	0.6491	FE	8.75

COPPER

RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
8.929	8.32	2.93	2177.	0.6478	FE	8.75
8.929	8.28	2.94	2174.	0.6449	FE	8.75

US = A0 + A1*UP KM/SEC
A0 = 4.008 KM/SEC SIG A0 = 0.037 KM/SEC
A1 = 1.477 - SIG A1 = 0.015 -
SIG US = 0.055 -

TABLE V

-----SAMPLE-----					-----STANDARD-----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
8.923	4.59	0.48	197.	0.8954	TU-3 MO	3.20
8.923	4.60	0.48	197.	0.8957	TU-3 MO	3.20
8.930	4.80	0.61	261.	0.8729	TU-3 MO	3.37
8.930	4.79	0.61	261.	0.8727	TU-3 MO	3.37
8.923	4.81	0.62	266.	0.8711	TU-3 MO	3.38
8.923	4.80	0.62	266.	0.8708	TU-3 MO	3.38
8.918	5.24	0.83	388.	0.8416	TU-3 MO	3.66
8.921	5.24	0.83	388.	0.8416	TU-3 MO	3.66
8.930	5.22	0.86	401.	0.8352	TU-3 MO	3.70
8.930	5.21	0.86	400.	0.8349	TU-3 MO	3.70
8.930	5.33	0.94	447.	0.8236	TU-3 MO	3.81
8.930	6.01	1.34	719.	0.7770	TU-3 MO	4.34
8.929	5.98	1.38	737.	0.7692	TU-3 MO	4.38
8.930	6.18	1.50	828.	0.7573	TU-3 MO	4.53
8.920	6.25	1.52	847.	0.7568	TU-3 MO	4.56
8.929	7.36	2.31	1518.	0.6861	TU-3 MO	5.59
8.931	7.72	2.46	1696.	0.6813	TU-3 MO	5.79
8.930	8.47	2.87	2171.	0.6612	TU-3 MO	6.35

US = A0 + A1*UP KM/SEC
A0 = 3.852 KM/SEC SIG A0 = 0.025 KM/SEC
A1 = 1.575 - SIG A1 = 0.018 -
SIG US = 0.054 -

TABLE VI

-----SAMPLE-----					-----STANDARD-----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
7.877	3.38	0.63	168.	0.8136	CU	4.71
7.885	3.32	0.65	170.	0.8042	CU	4.73
7.780	3.71	0.78	225.	0.7898	CU	4.92
7.880	3.77	0.82	244.	0.7825	CU	4.98
7.897	4.50	1.11	394.	0.7533	CU	5.40
7.908	4.55	1.18	403.	0.7538	CU	5.42
7.878	4.41	1.18	403.	0.7370	CU	5.45

COPPER

RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
7.914	4.75	1.18	444.	0.7516	CU	5.51
7.880	5.00	1.39	548.	0.7220	CU	5.80
7.910	5.78	1.76	805.	0.6955	CU	6.35
7.932	5.69	1.79	808.	0.6854	CU	6.37
7.881	6.65	2.31	1211.	0.6526	CU	7.13
7.927	6.64	2.33	1226.	0.6491	CU	7.15
7.894	6.73	2.33	1242.	0.6548	CU	7.17
7.915	7.01	2.47	1370.	0.6476	CU	7.38
7.968	7.23	2.59	1492.	0.6418	CU	7.57
7.995	7.84	2.93	1837.	0.6263	CU	8.07
7.866	7.76	2.97	1813.	0.6173	CU	8.09

US =

TABLE VII

---------------SAMPLE-------------------					-----STANDARD-----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
7.368	3.00	0.67	148.	0.7767	CU	4.71
7.384	2.78	0.70	144.	0.7482	CU	4.73
7.182	3.32	0.84	200.	0.7470	CU	4.92
7.364	3.32	0.88	215.	0.7349	CU	4.98
7.208	4.09	1.19	351.	0.7090	CU	5.40
7.201	4.12	1.21	359.	0.7063	CU	5.42
7.384	4.15	1.22	373.	0.7060	CU	5.45
7.193	4.33	1.27	396.	0.7067	CU	5.51
7.354	4.72	1.46	507.	0.6907	CU	5.80
7.216	5.44	1.86	730.	0.6581	CU	6.35
7.372	5.47	1.87	754.	0.6581	CU	6.37
7.489	6.52	2.39	1167.	0.6334	CU	7.15
7.366	6.42	2.40	1135.	0.6262	CU	7.13
7.219	6.53	2.44	1150.	0.6263	CU	7.17
7.201	6.62	2.61	1244.	0.6057	CU	7.38
7.384	6.98	2.70	1392.	0.6132	CU	7.57
7.376	7.51	3.06	1695.	0.5925	CU	8.07
7.374	7.59	3.06	1713.	0.5968	CU	8.09

US =

TABLE VIII

---------------SAMPLE-------------------					-----STANDARD-----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
6.372	2.41	0.74	114.	0.6929	CU	4.71
6.322	2.28	0.78	112.	0.6579	CU	4.73
6.270	2.80	0.92	162.	0.6714	CU	4.92
6.325	2.79	0.97	171.	0.6523	CU	4.98

COPPER

RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
6.290	3.56	1.30	291.	0.6348	CU	5.40
6.309	3.64	1.31	301.	0.6401	CU	5.42
6.395	3.69	1.33	314.	0.6396	CU	5.45
6.279	3.89	1.37	335.	0.6478	CU	5.51
6.300	4.27	1.59	428.	0.6276	CU	5.80
6.278	5.08	2.00	638.	0.6063	CU	6.35
6.332	5.10	2.01	649.	0.6059	CU	6.37
6.392	6.17	2.56	1010.	0.5851	CU	7.13
6.350	6.13	2.58	1004.	0.5791	CU	7.15
6.278	6.14	2.61	1006.	0.5749	CU	7.17
6.264	6.39	2.77	1109.	0.5665	CU	7.38
6,327	6.70	2.89	1225.	0.5687	CU	7.57
6.342	7.37	3.26	1524.	0.5577	CU	8.09
6.343	7.21	3.27	1495.	0.5465	CU	8.07

US =

TABLE IX

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
5.983	2.26	0.77	104.	0.6593	CU	4.71
5.833	2.22	0.80	104.	0.6396	CU	4.73
5.567	2.51	0.98	137.	0.6096	CU	4.92
5.718	?.61	1.01	151.	0.6130	CU	4.98
5.564	3.35	1.37	255.	0.5910	CU	5.40
5.830	3.52	1.38	283.	0.6080	CU	5.45
5.605	3.38	1.39	263.	0.5888	CU	2.42
5.605	3.65	1.45	297.	0.6027	CU	5.51
5.876	4.17	1.64	402.	0.6067	CU	5.80
5.712	4.95	2.10	594.	0.5758	CU	6.37
5.557	4.87	2.10	568.	0.5688	CU	6.35
5.978	6.10	2.62	955.	0.5705	CU	7.13
5.785	5.93	2.69	923.	0.5464	CU	7.15
5.627	5.99	2.72	917.	0.5459	CU	7.17
5.598	6.20	2.89	1003.	0.5339	CU	7.38
5.892	6.72	2.95	1168.	0.5610	CU	7.57
5.972	7.33	3.33	1458.	0.5457	CU	8.09
5.801	7.20	3.36	1403.	0.5333	CU	8.07

US =

TABLE X

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
4.453	2.83	1.50	189.	0.4700	CU	5.40

COPPER

RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
4.467	2.92	1.52	198.	0.4795	CU	5.42
4.533	3.21	1.58	230.	0.5078	CU	5.51
4.577	5.63	2.94	758.	0.4778	CU	7.17
4.513	5.86	3.13	828.	0.4658	CU	7.38

US =

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES, HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII
2) EXPERIMENTAL TECHNIQUE: B
DATA REDUCTION TECHNIQUE: A (TABLE I) B (THE REST)
3) TABLE I IS THE STANDARD HUGONIOT OBTAINED FROM SYMMETRIC IMPACT. TABLES II THROUGH V CHECK THE INTERNAL CONSISTENCY OF THE OTHER HUGONIOTS OBTAINED WITH SYMMETRIC IMPACTS.
4) THE GRUNEISEN GAMMA OF 1.96 (= GAM) WITH THE ASSUMPTION THAT RHO.GAM = CONSTANT REPRESENTS THE BEHAVIOR OF THE POROUS SAMPLES. ALSO LISTED (DV/DT)/V = 4.89E-5 PER DEG. AND CP= 0.389 JOULES PER G. DEG.
5) VOI WAS CALCULATED FROM THE LATTICE CONSTANTS IN WYCKOFF, CRYSTAL STRUCTURES (JOHN WILEY AND SONS, N.Y., 1963) VOL. 1.
6) HUGONIOT ELASTIC LIMIT 0. - 6.3 KBAR (ANNEALED - 50 PERCENT COLD WORKED RESP.)
HUGONIOT ELASTIC LIMIT
7) THE 921-T AL PLATE STOCK USED TO OBTAIN THE CROSS CHECK DATA IN TABLE III IS SLIGHTLY POROUS.

TABLE I

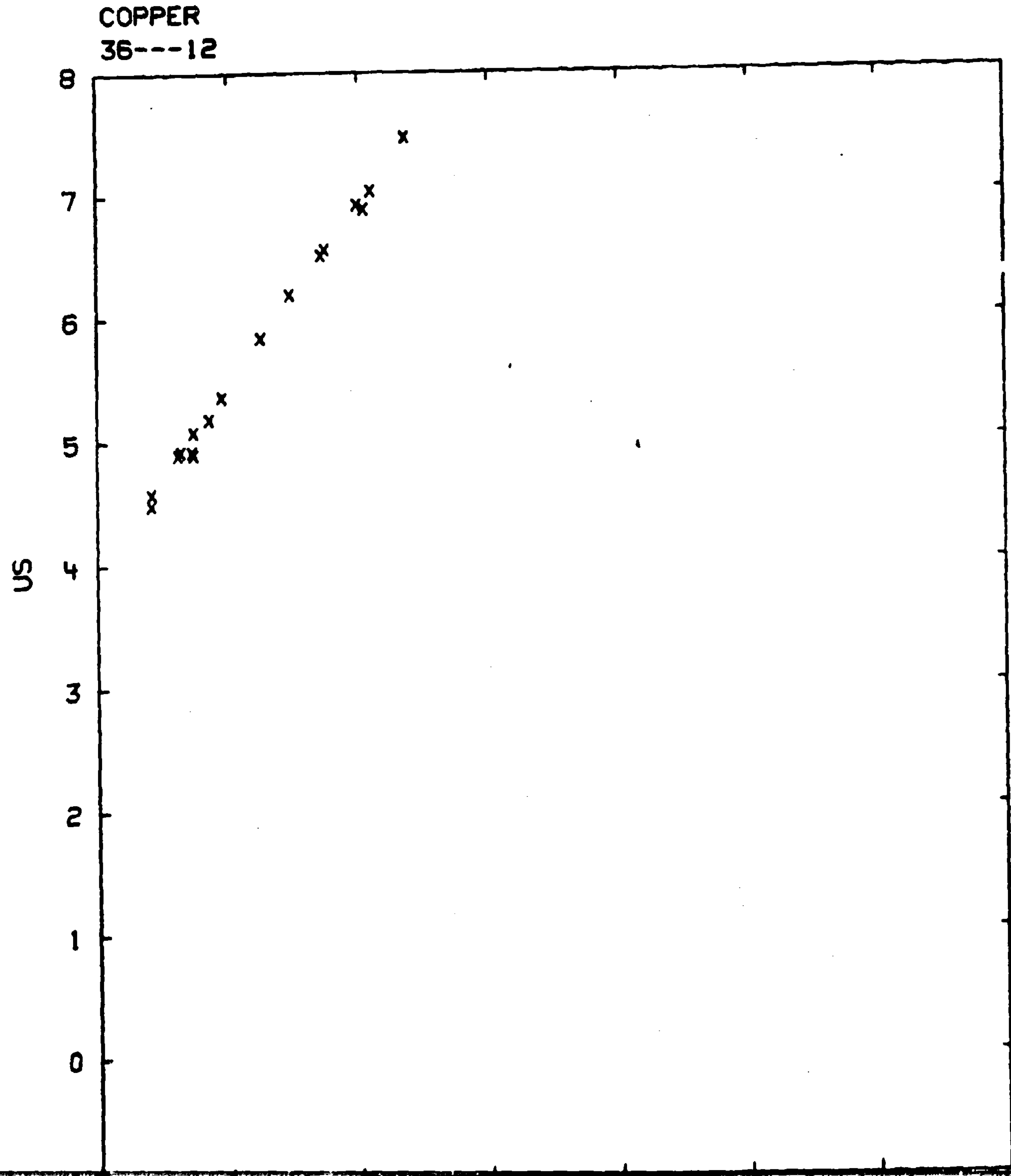


TABLE II

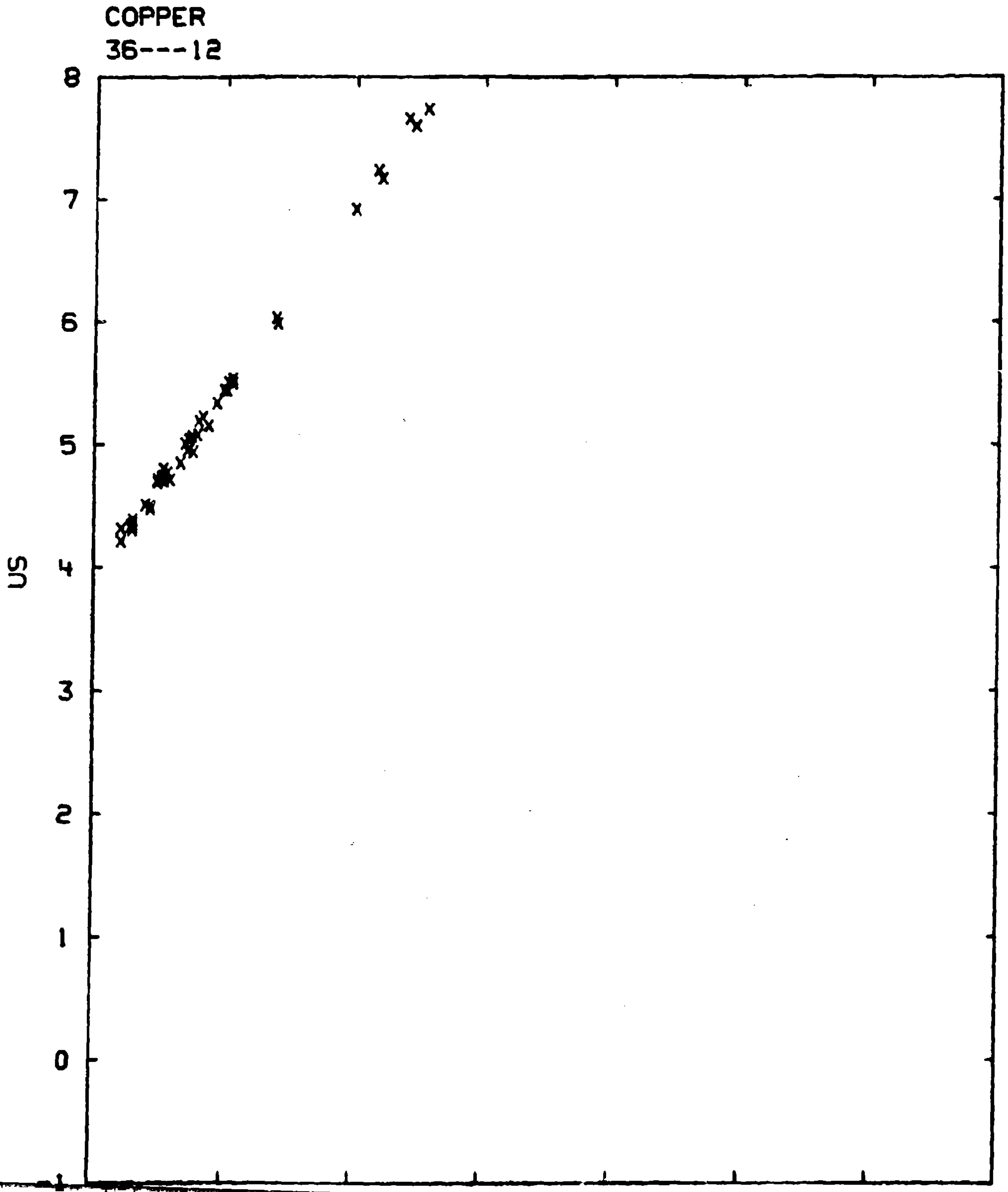


TABLE III

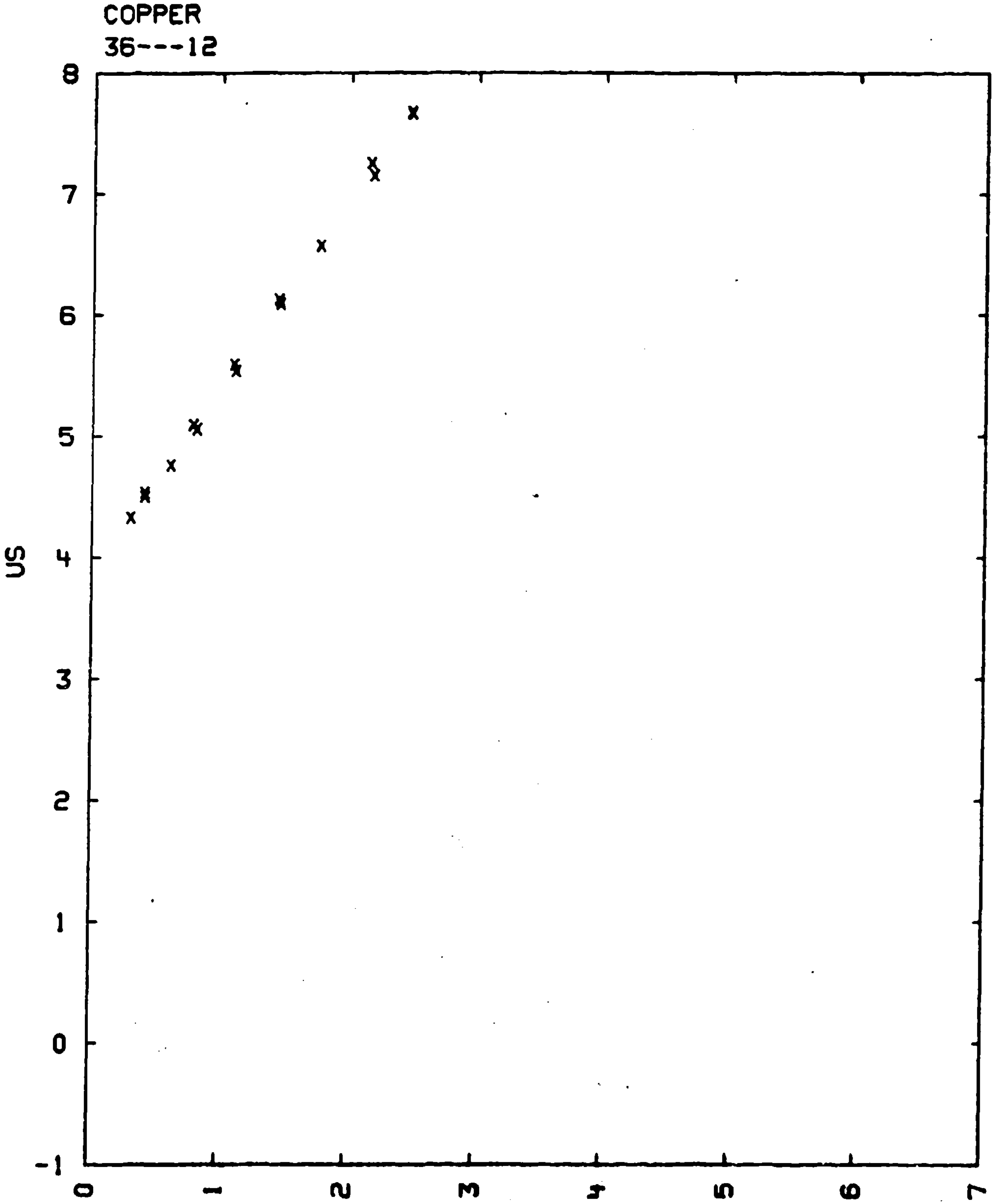


TABLE IV

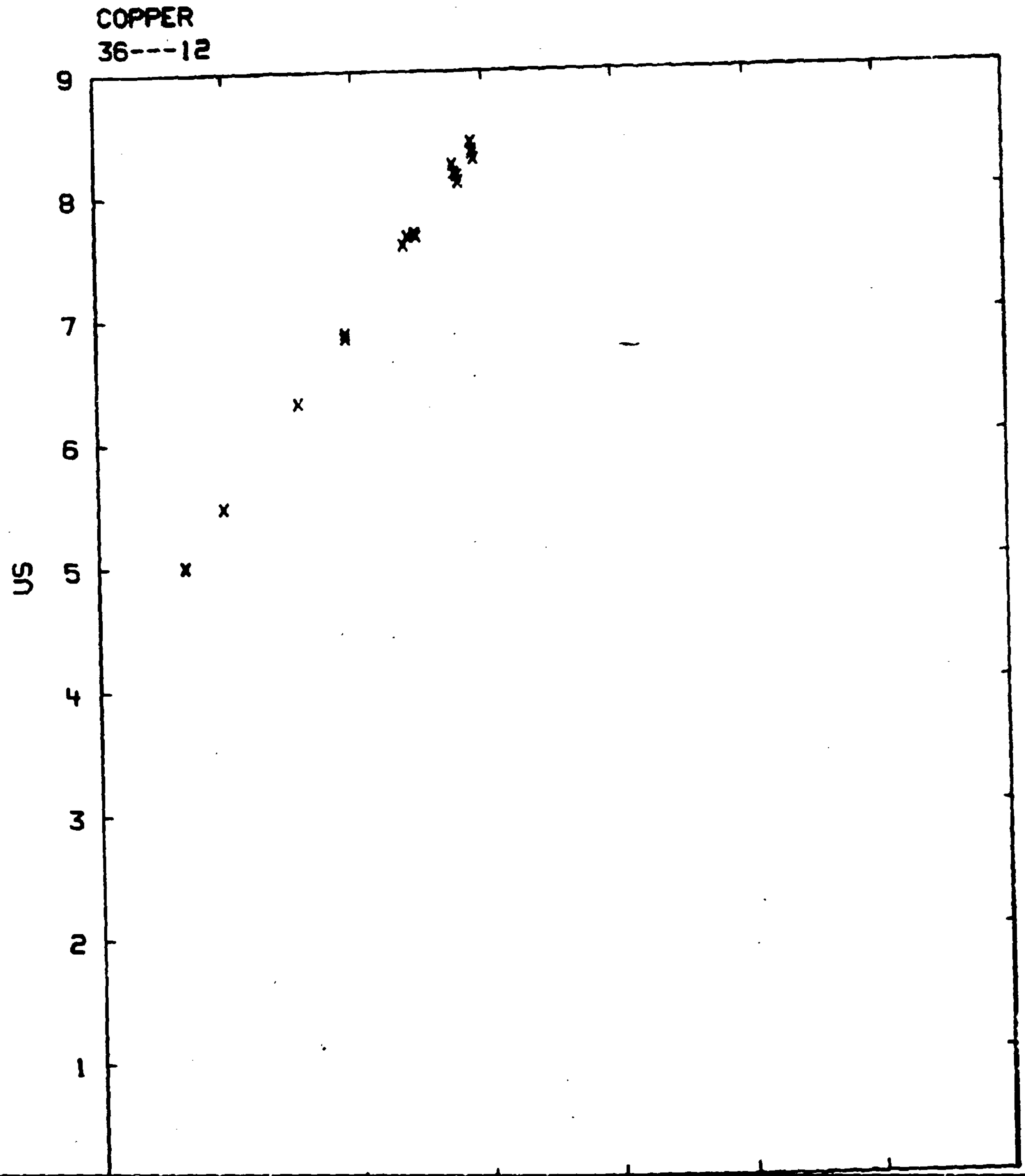


TABLE V

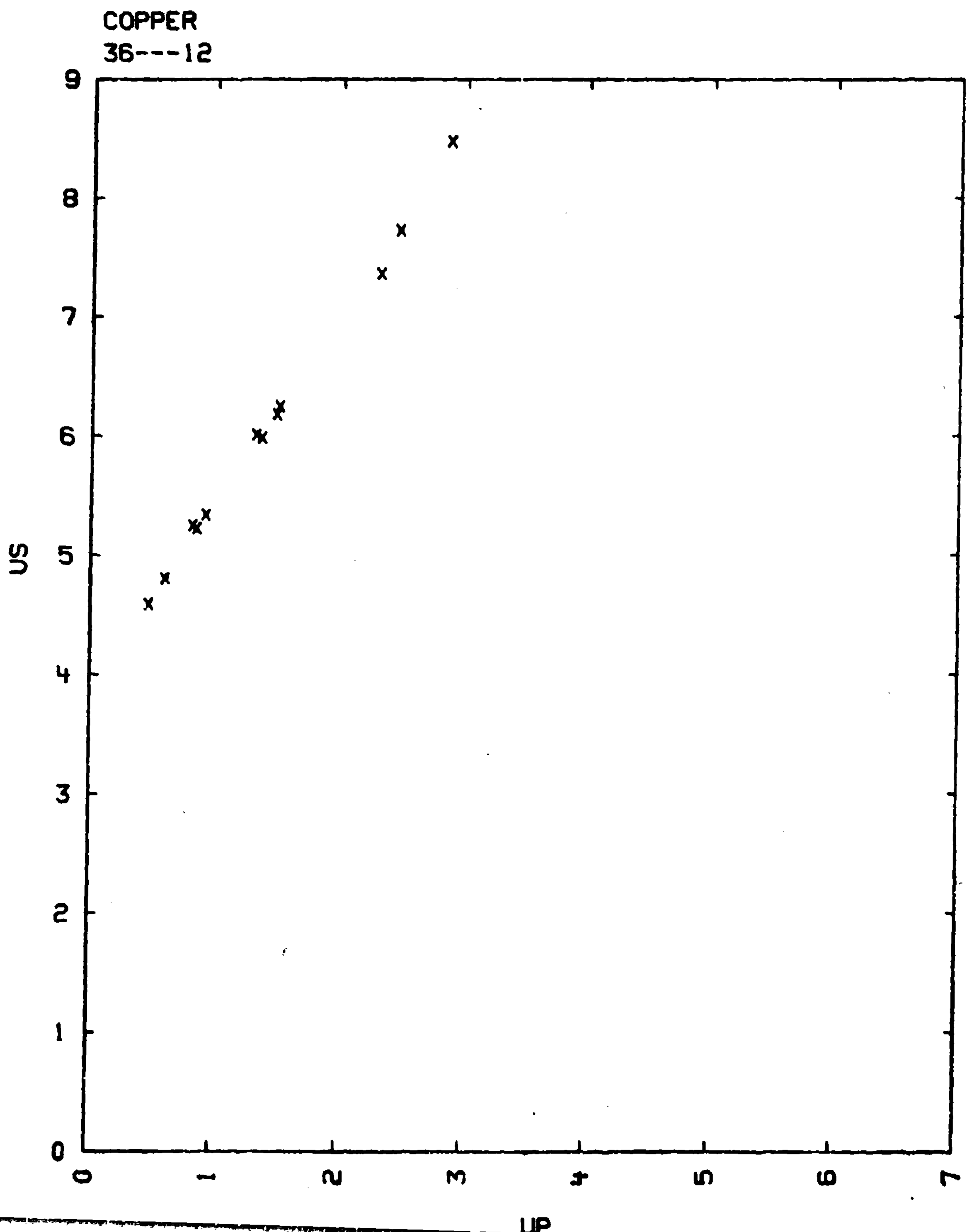


TABLE VI

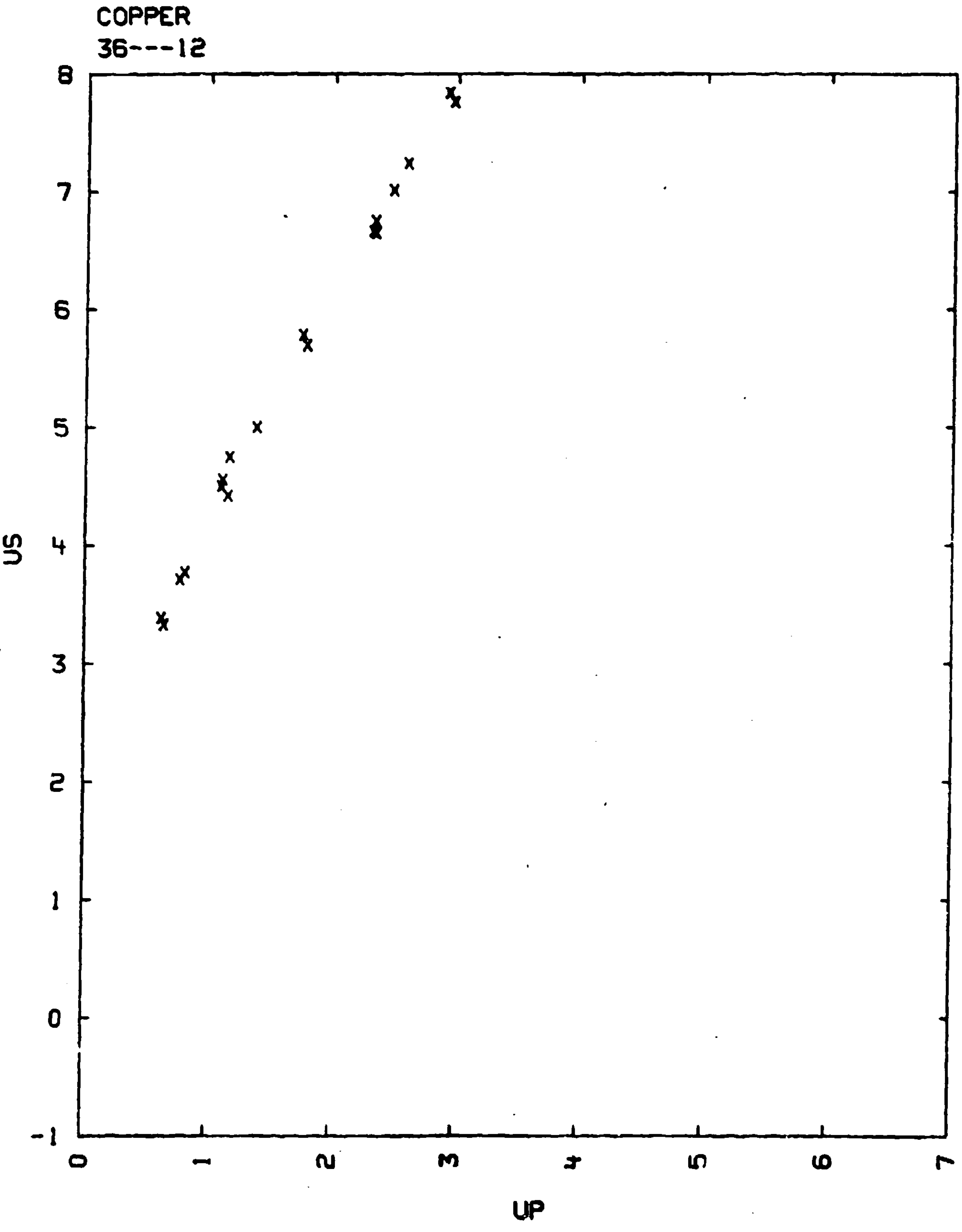


TABLE VII

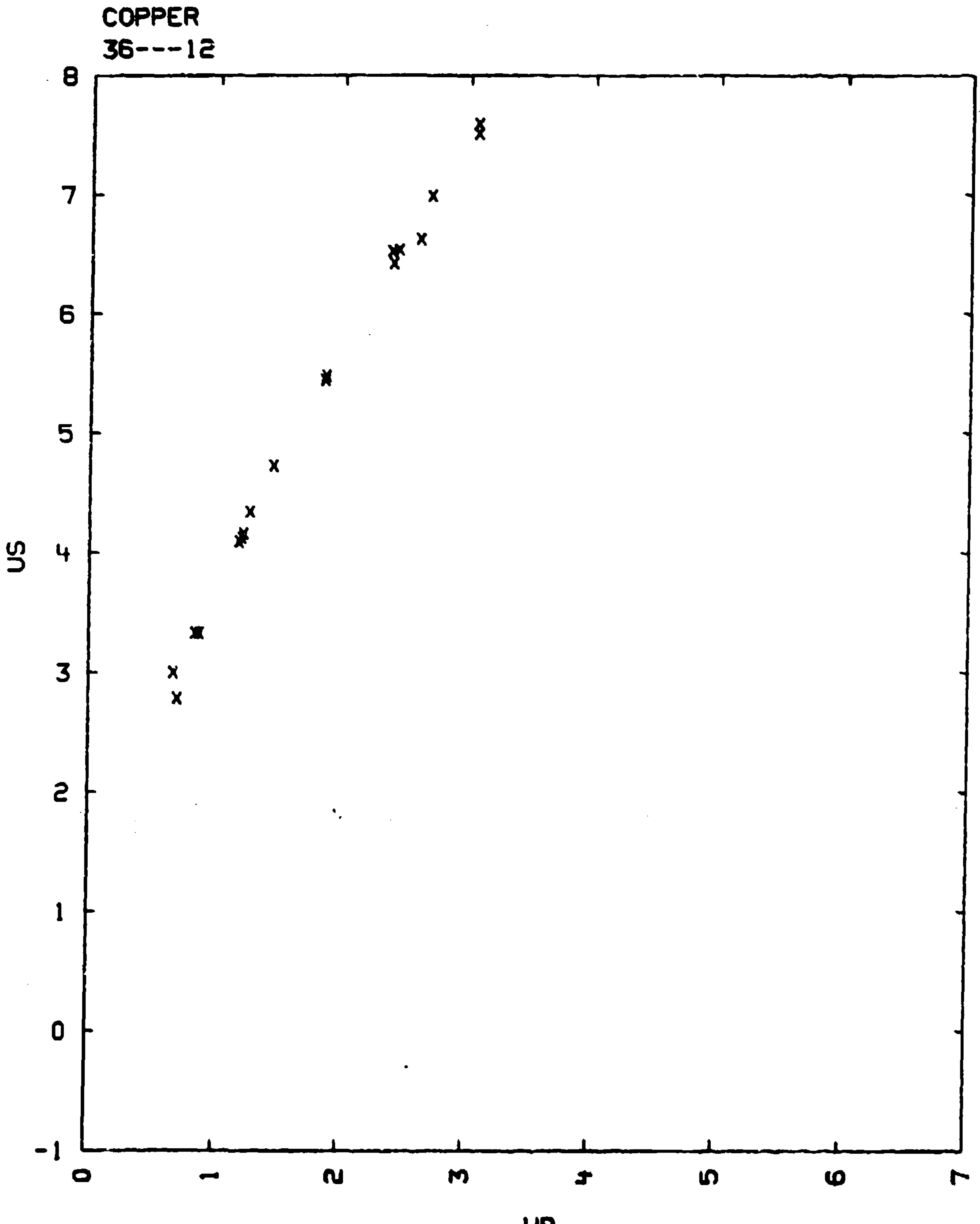


TABLE VIII

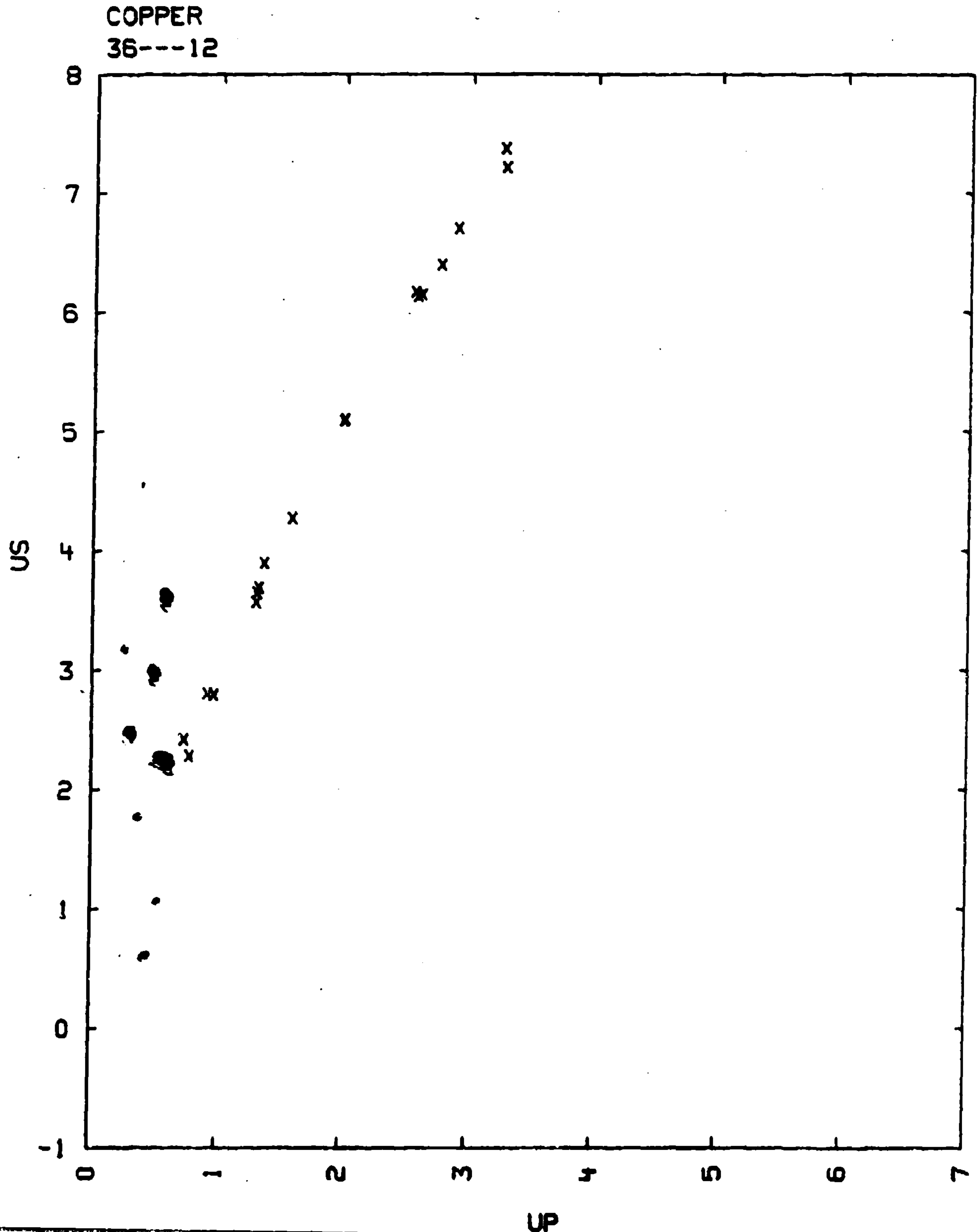


TABLE IX

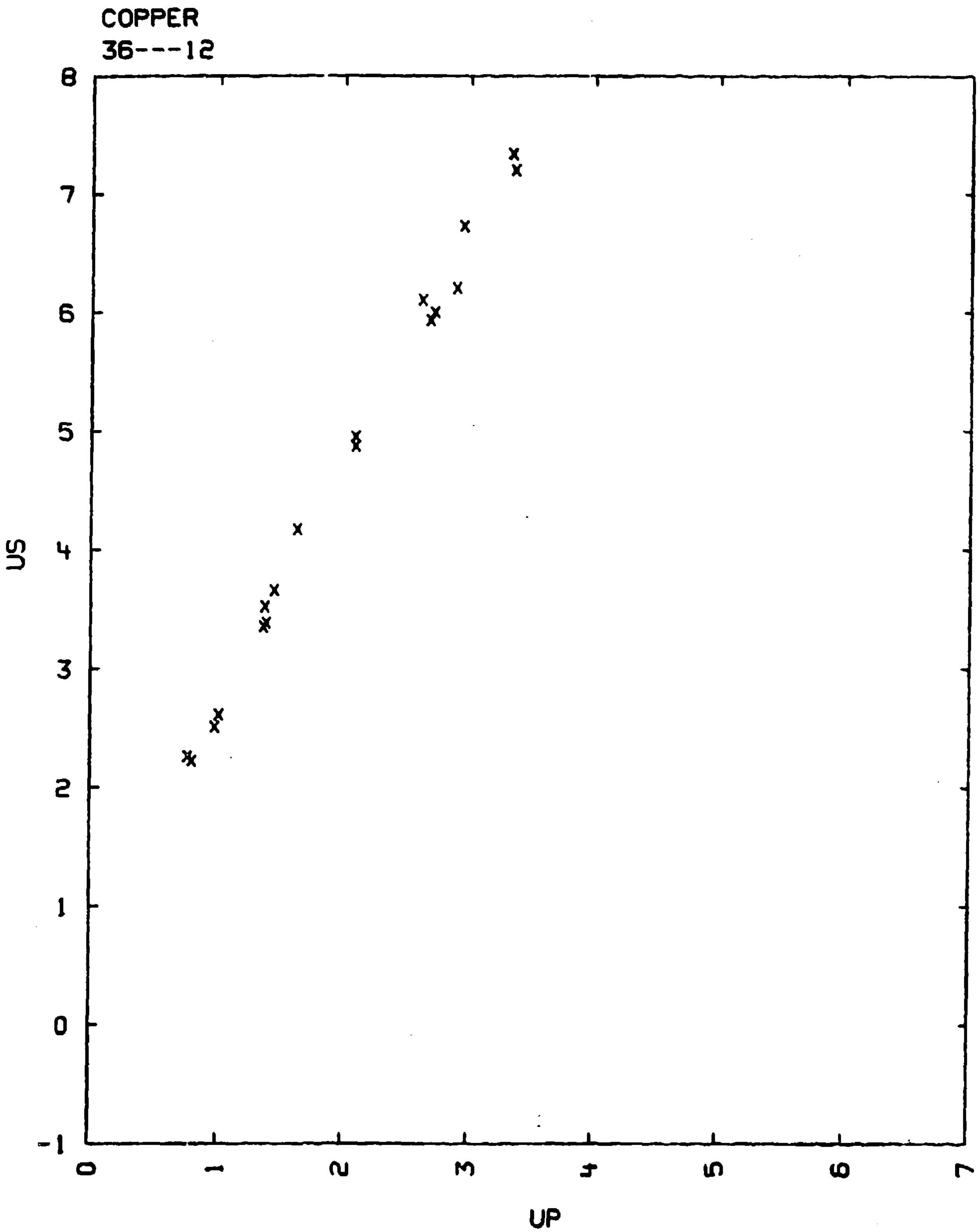
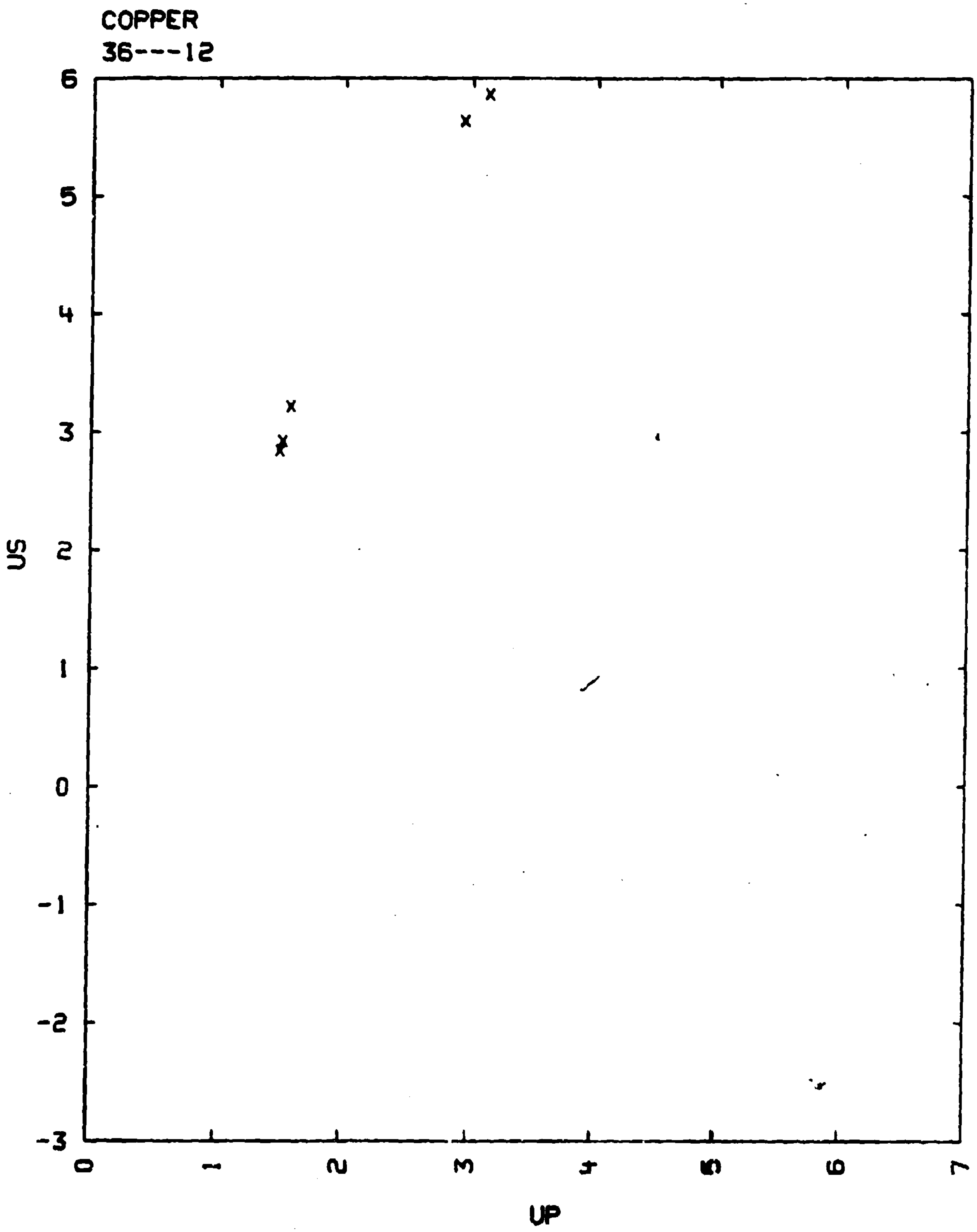


TABLE X



37---0
SILVER SUMMARY

AG

VO = 0.09533 CC/G   CL = 3.80 KM/SEC   CO = 3.09 KM/SEC
VO1= 0.09533 CC/G   CS = 1.59 KM/SEC   CB = 3.19 KM/SEC

THE TABLE LISTS THE HUGONIOT POINTS CALCULATED FROM THE POLYNOMIAL FIT GIVEN BELOW. UNITS ARE: G/CC, KM/SEC, KILOBARS AND KBAR.CC/G FOR THE ENERGY DIFFERENCE.

TABLE

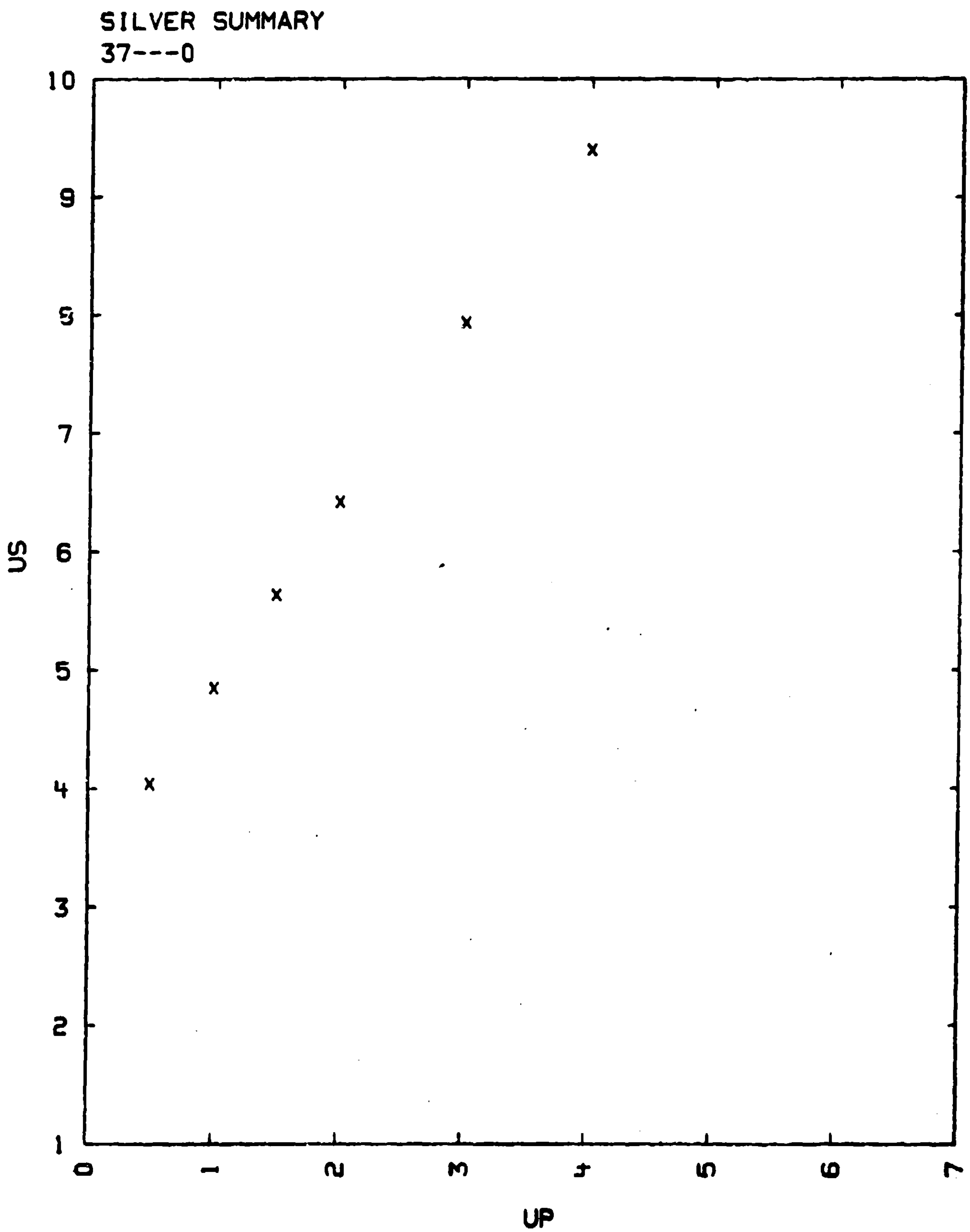
RHOO	US	UP	P	V/VO	E-EO
10.49	4.037	0.5	212	0.876	1.25
-	4.842	1.0	508	0.793	5.0
-	5.633	1.5	886	0.734	11.25
-	6.411	2.0	1345	0.688	20.0
-	7.928	3.0	2495	0.622	45.0
-	9.393	4.0	3941	0.574	80.0

US = 3.220 + 1.648*UP - 0.0262*UP**2, SIG.US = 0.06 KM/SEC
FOR UP BETWEEN 0.5 AND 4 KM/SEC

COMMENTS

1) SOURCE: COMPILER
2) THE QUADRATIC TERM IN THE FIT IS CAUSED BY THE SINGLE HIGHEST
TV80LIB DD80 OUTPUT........... 12:15:52U 08/14
THE FIT WAS MADE FROM THE DATA OF PAGE 37---1,2 AND 3.
3) MORE RECENT SOUND VELOCITY DATA THAN THOSE LISTED ABOVE FROM PAGE 37---1 YIELD A VALUE OF CO = 3.14 KM/SEC:
W. B. DANIELS AND C. S. SMITH, PHYS. REV., VOL. 111, P. 713 (1958).

TABLE I



37---1
SILVER

AG 99.9 PER CENT OR GREATER

V0 = 0.09533 CC/G. CL = 3.60 KM/SEC. C0 = 3.09 KM/SEC
V01= 0.09533 CC/G. CS = 1.59 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN MM/MICROSEC.
PRESSURES IN KILOBARS, AND DENSITY IN G/CC.

TABLE

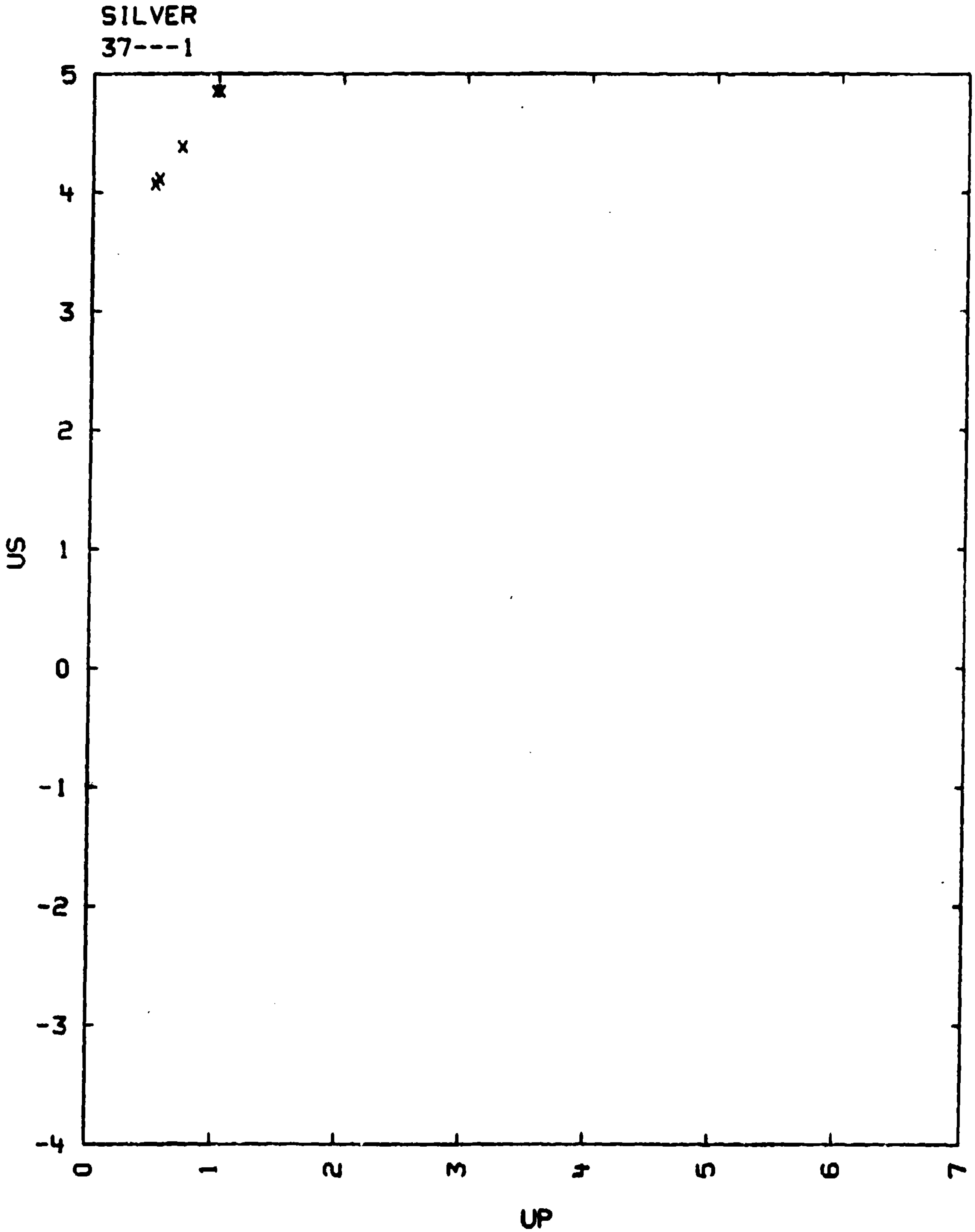
RHO0	US	UFS	UP	P	V/V0
10.49	4.065	1.015	0.504	214.9	0.8760
-	4.113	1.049	0.527	227.4	0.8719
-	4.378	1.448	0.717	329.3	0.8362
-	4.846	2.041	0.985	500.7	0.7967
-	4.848	2.074	1.010	513.6	0.7917

US = 3.271 + 1.575 UP KM/SEC SIGMA US = 0.5 PERCENT

COMMENTS:

1) SOURCE: WALSH, J. M., RICE, M. H., MCQUEEN, R. G. AND YARGER, F. L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 1 PER CENT IN COMPRESSION AT A GIVEN PRESSURE.
4) IMPURITIES WERE OBTAINED BY SPECTROCHEMICAL ANALYSIS
5) CL AND CS WERE OBTAINED FROM L. BERGMAN, DER ULTRASCHALL, S. HIRZEL VERLAG, STUTTGART, 1954, 6TH ED., P. 650

TABLE I



37---2
SILVER

AG

V0 = 0.09532 CC/G.
V01 = 0.09532 CC/G.

C0 = 0.319 KM/SES.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC,
PRESSURES IN KILOBARS, AND DENSITY IN G/CC.

TABLE

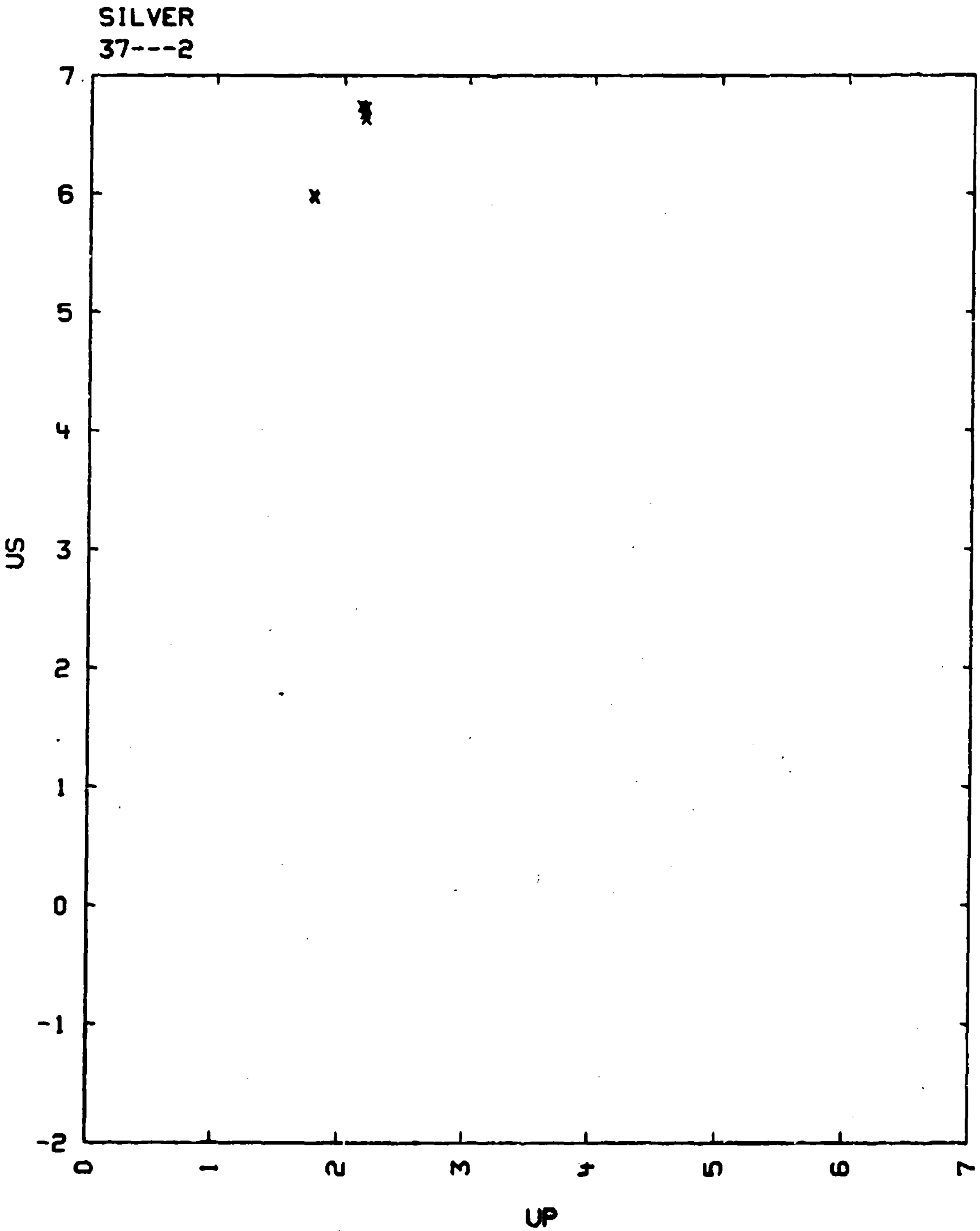
RHO0	US	UP	P	V/V0	PRESSURE IN BRASS STANDARD
10.49	5.98	1.77	1107	0.705	1027
-	5.96	1.78	1109	0.702	1034
-	6.73	2.14	1512	0.681	1378
-	6.63	2.17	1509	0.673	1388
-	6.68	2.16	1510	0.677	1393
-	6.72	2.17	1530	0.677	1399

US = 3.243 + 1.586 UP KM/SEC. SIGMA US = 0.55 PERCENT

COMMENTS:

1) SOURCE: MCQUEEN, R. G. AND MARSH, S. P.
J. APPL. PHYS., VOL. 31, P. 1253 (1960)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS BRASS
3) FOR THE BRASS STANDARD DATA SEE MATERIAL 36-33
4) V01 WAS TAKEN FROM THE AMERICAN INSTITUTE OF PHYSICS HANDBOOK
(MCGRAW-HILL BOOK CO., N.Y., 1963) 2ND ED.

TABLE I



37---3
SILVER

AG

VO = 0.09533 CC/G.
VOI = 0.09533 CC/G. CB = 3.14 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURES IN KILOBARS AND DENSITY IN G/CC.

TABLE

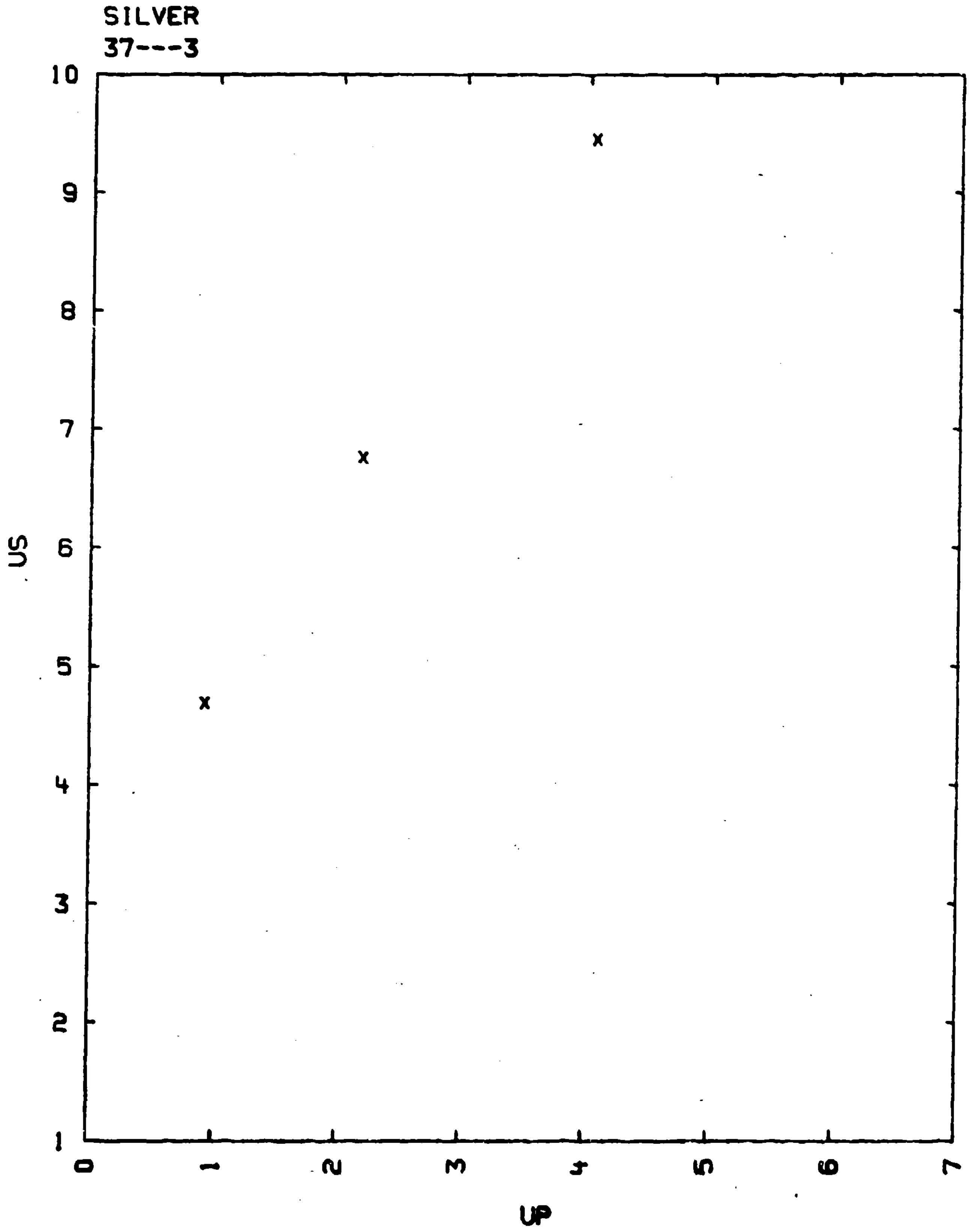
RHOO	US	UP	P	V/VO
10.49	4.69	0.93	460	0.800
-	6.76	2.19	1550	0.576
-	9.45	4.05	4010	0.571

US = 3.30 + 1.54UP KM/SEC.

COMMENTS:

1) SOURCE: AL'TSHULER, L. V., KRUPNIKOV, K. K. AND BRAZHNIK, M. I. SOVIET PHYS.-JETP, VOL. 34, P. 614 (1958)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL FE.
3) CB IS CALCULATED USING THE VOLUME COMPRESSION COEFFICIENT TAKEN FROM P. W. BRIDGMAN, THE PHYSICS OF HIGH PRESSURE, (G. BELL AND SONS LTD. LONDON 1958)
4) VOI WAS OBTAINED FROM THE AMERICAN INSTITUTE OF PHYSICS HANDBOOK, (MCGRAW-HILL BOOK CO., N.Y., 1963) 2ND ED.
5) THE SPECIMEN WITH A THICKNESS BETWEEN 6-8MM. WAS ATTACHED TO A IRON PLATE OF COMPARABLE THICKNESS 6-9MM.

TABLE I



38---0
GOLD SUMMARY

AU

VO = 0.0518-0.0520 CC/G   CL = 3.24 KM/SEC   CO = 2.93 KM/SEC
VOI= 0.05185 CC/G   CS = 1.20 KM/SEC   CB = 3.05 KM/SEC

THE TABLE LISTS HUGONIOT POINTS CALCULATED FROM THE FIT GIVEN BELOW.
UNITS ARE: G/CC, KM/SEC, KBARS AND KBAR.CC/G FOR THE ENERGY DIFFERENCE.

TABLE

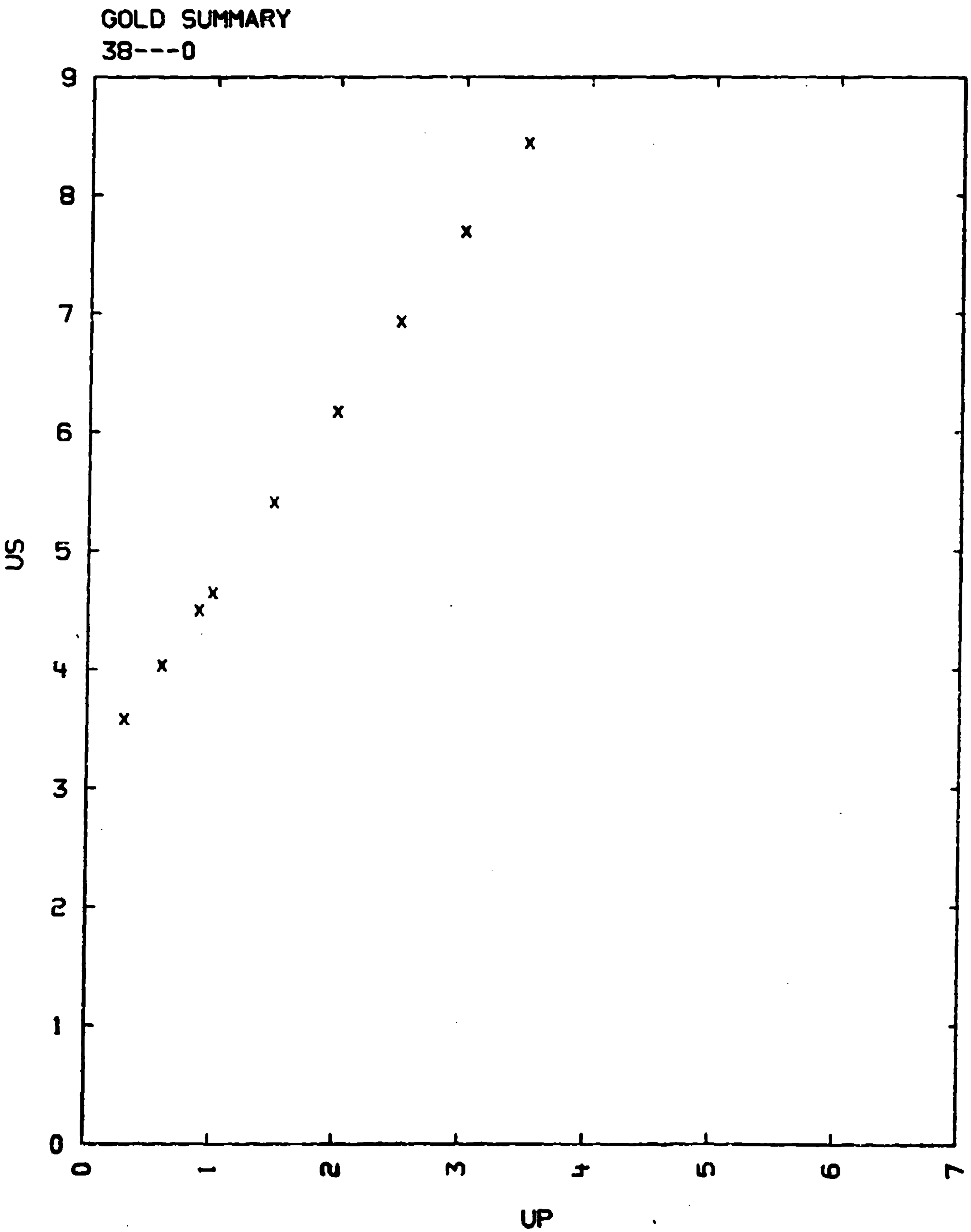
RHOO	US	UP	P	V/VO	E-EO
19.29	3.576	.3	207.	0.9161	0.45
-	4.032	.6	467.	0.8512	1.8
-	4.489	.9	779.	0.799	4.05
-	4.641	1.	895.	0.784	5.00
-	5.401	1.5	1563.	0.722	11.25
-	6.162	2.0	2377.	0.675	20.0
-	6.922	2.5	3338.	0.639	31.2
-	7.683	3.0	4446.	0.610	45.0
-	8.443	3.5	5701.	0.585	61.2

US = 3.120 + 1.521 UP,   SIG.US = 0.056 KM/SEC.
FOR UP BETWEEN 0.33 AND 3.5 KM/SEC

COMMENTS:

1) SOURCE: COMPILER
1A) THE FIT WAS MADE TO ALL DATA OF 38---1,2,3 AND 4.
2) ALL POINTS WERE WEIGHTED EQUALLY
3) VOI WAS CALCULATED FROM THE CUBIC UNIT CELL CONSTANT A = 4.07825 ANGSTROM AT 25 DEG. C.
WYCKOFF, CRYSTAL STRUCTURES, VOL. 1 (INTERSCIENCE PUBL. 1963) 2ND ED.
3) MORE RECENT SOUND VELOCITY DATA THAN THOSE LISTED ABOVE FROM PAGE 38---1 YIELD A VALUE OF CO = 2.99 KM/SEC:
W. B. DANIELS AND C. S. SMITH, PHYS. REV., VOL. 111, P. 713 (1958).

TABLE I



38---1
GOLD

AU 99.8 PER CENT OR GREATER

VO = 0.0520 CC/G.   CL = 3.24 KM/SEC.   CO = 2.93 KM/SEC.
VOI = 0.0516 CC/G.   CS = 1.20 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC.
PRESSURE IN KILOBARS, AND DENSITY IN G/CC.

TABLE

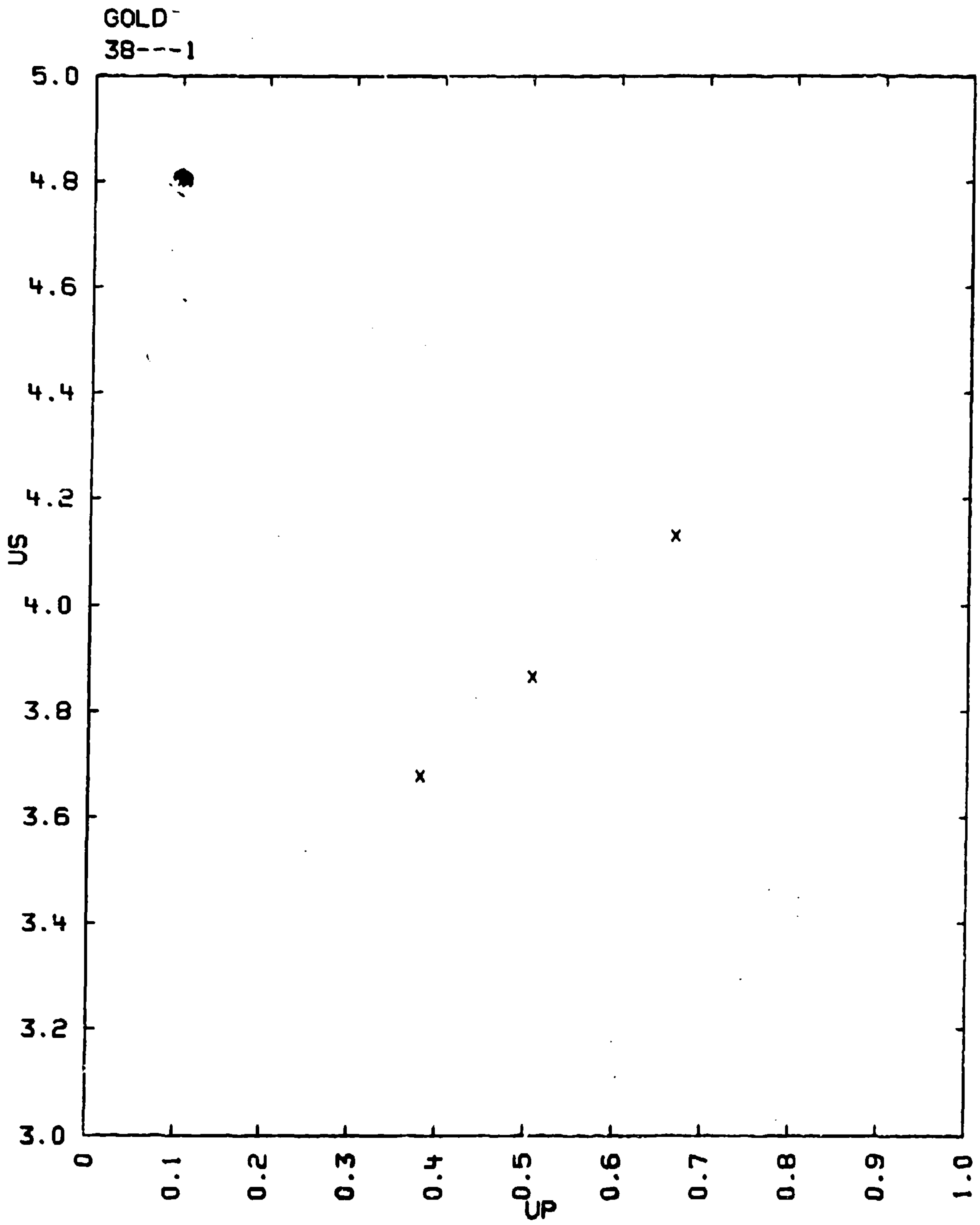
RHOO	US	UFS	UP	P	V/VO
19.24	3.679	0.771	0.380	269.0	0.8967
-	3.864	1.012	0.505	375.4	0.8693
-	4.130	1.375	0.666	529.2	0.8389

US = 3.074 + 1.580 UP KM/SEC   SIGMA US = 0.3 PERCENT

COMMENTS:

1) SOURCE: WALSH, J.M., RICE, M.H., MCQUEEN, R.G. AND YARGER, F.L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS.
4) CL AND CS VALUES WERE OBTAINED FROM L. BERGMAN, DER ULTRASCHALL,
(S. HIRZEL VERLAG, STUTTGART, GERMANY, 1954) 6TH ED., P.650
5) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY
FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 1 PER CENT IN
COMPRESSION AT A GIVEN PRESSURE

TABLE I



GOLD
38---1
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
US
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP

38---2
GOLD

AU

V0 = 0.0520 CC/G. CO = 3.05 KM/SEC.
V0I = 0.05183 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PESSURES IN KILOBARS AND DENSITY IN G/CC

TABLE

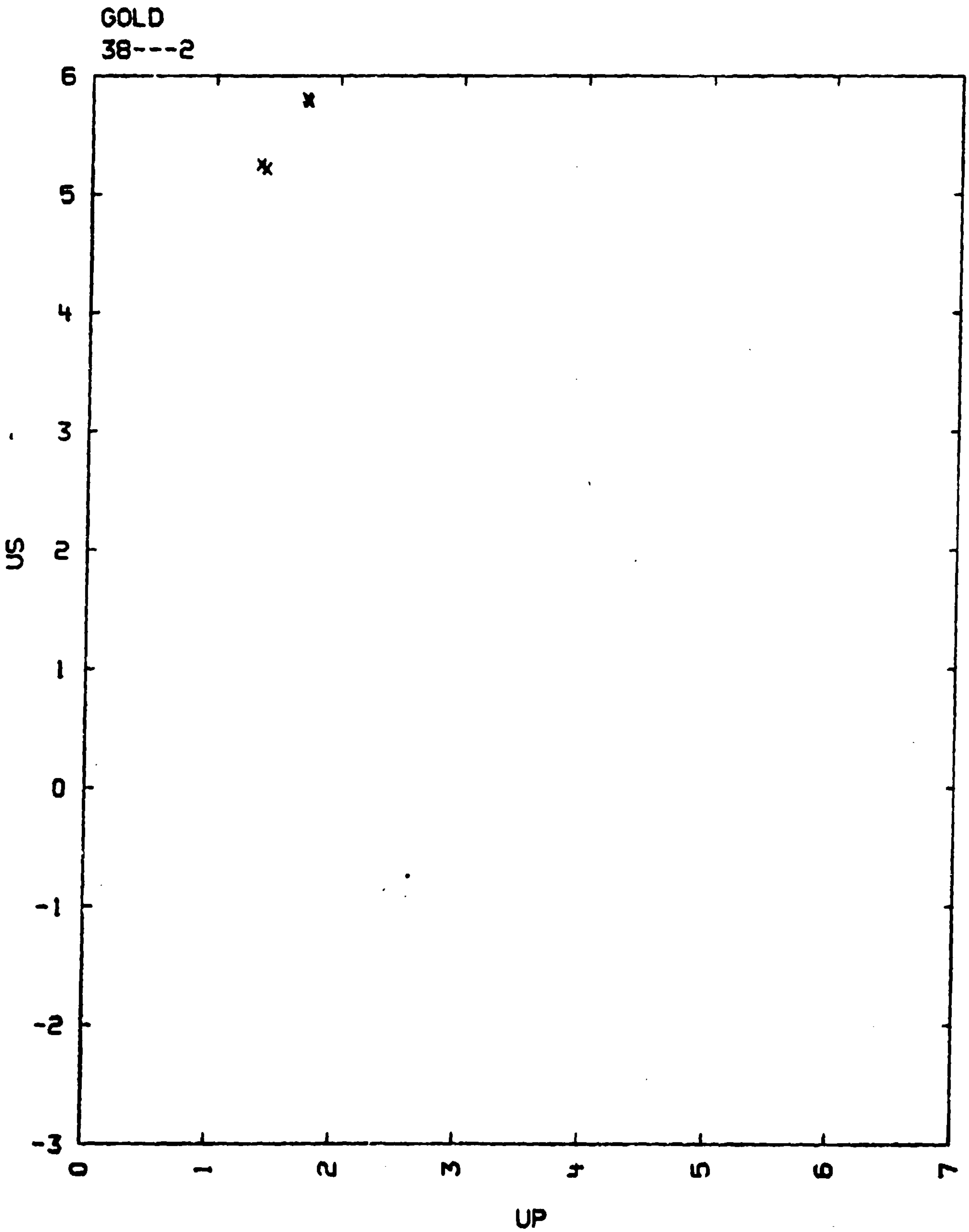
RHOO	US	UP	P	V/VO	PRESSURE IN BRASS STANDARD
19.24	5.25	1.37	1387	0.739	1002
-	5.21	1.41	1410	0.730	1025
-	5.80	1.73	1932	0.702	1384
-	5.78	1.74	1931	0.700	1387
-	5.78	1.74	1936	0.699	1398
-	5.79	1.74	1942	0.699	1399

US = 3.075 + 1.560 UP KM/SEC. SIGMA US = 0.30 PERCENT

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
J. APPL. PHYS., VOL. 31, P. 1253 (1960)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS BRASS
3) FOR THE BRASS STANDARD DATA SEE MATERIAL 36-33
4) V0I WAS TAKEN FROM THE A. I. P. HANDBOOK (MCGRAW HILL BOOK CO.)
2ND ED.

TABLE I



38---3
GOLD

AU

V0 = 0.0518 CC/G
V0I = 0.0518 CC/G   CB = 3.05 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

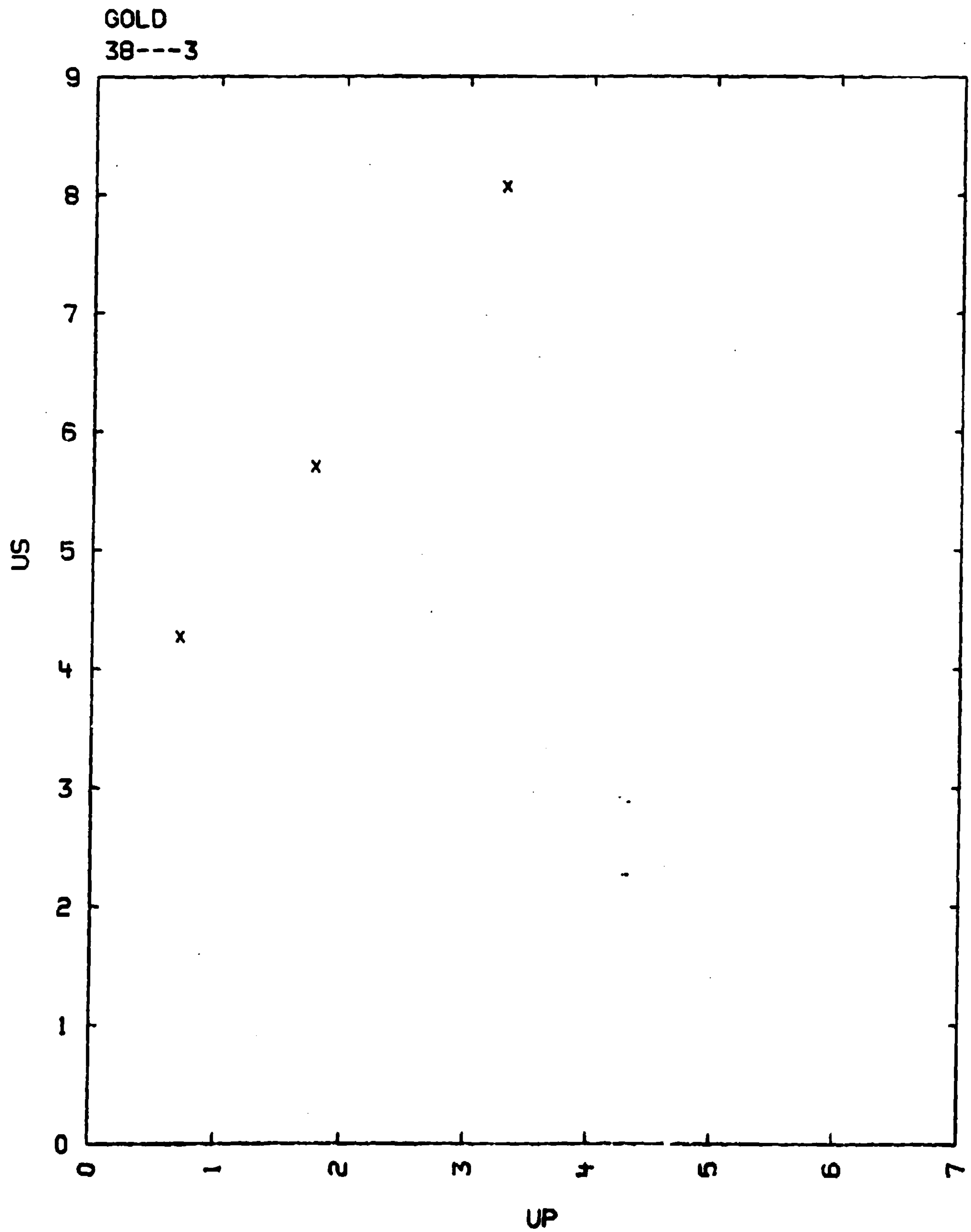
RHO0	US	UP	P	V/V0
19.30	4.27	0.71	590	0.833
-	5.70	1.78	1950	0.690
-	8.06	3.30	5130	0.592

US = 3.15 + 1.47UP KM/SEC.

COMMENTS:

1) SOURCE: AL'TSHULER, L. V., KRUPNIKOV, K. K. AND BRAZHNIK, M. I.
SOVIET PHYS.-JETP, VOL. 34, P. 614 (1958)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL FE.
3) CB IS CALCULATED USING THE VOLUME COMPRESSION COEFFICIENT TAKEN FROM P. W. BRIDGMAN, THE PHYSICS OF HIGH PRESSURE. (G. BELL AND SONS LTD. LONDON 1958)
4) V0I WAS OBTAINED FROM THE AMERICAN INSTITUTE OF PHYSICS HANDBOOK (MCGRAW-HILL BOOK CO. 1963) 2ND ED.
5) THE SPECIMEN WITH A THICKNESS BETWEEN 6-8MM. WAS ATTACHED TO A IRON PLATE OF COMPARABLE THICKNESS 6-9MM.

TABLE I



38---4
GOLD

AU 99.99 PERCENT
PD 0.0014 -
AG 0.0010 -
CU 0.00017 -
FE 0.0005 -
SI 0.0053 -
MG 0.00038 -

VO = 0.05176 CC/G
VOI = 0.05185 CC/G.

CO = 2.99 KM/SEC

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC., VELOCITIES IN KM/SEC., AND PRESSURE IN KILOBARS.

TABLE

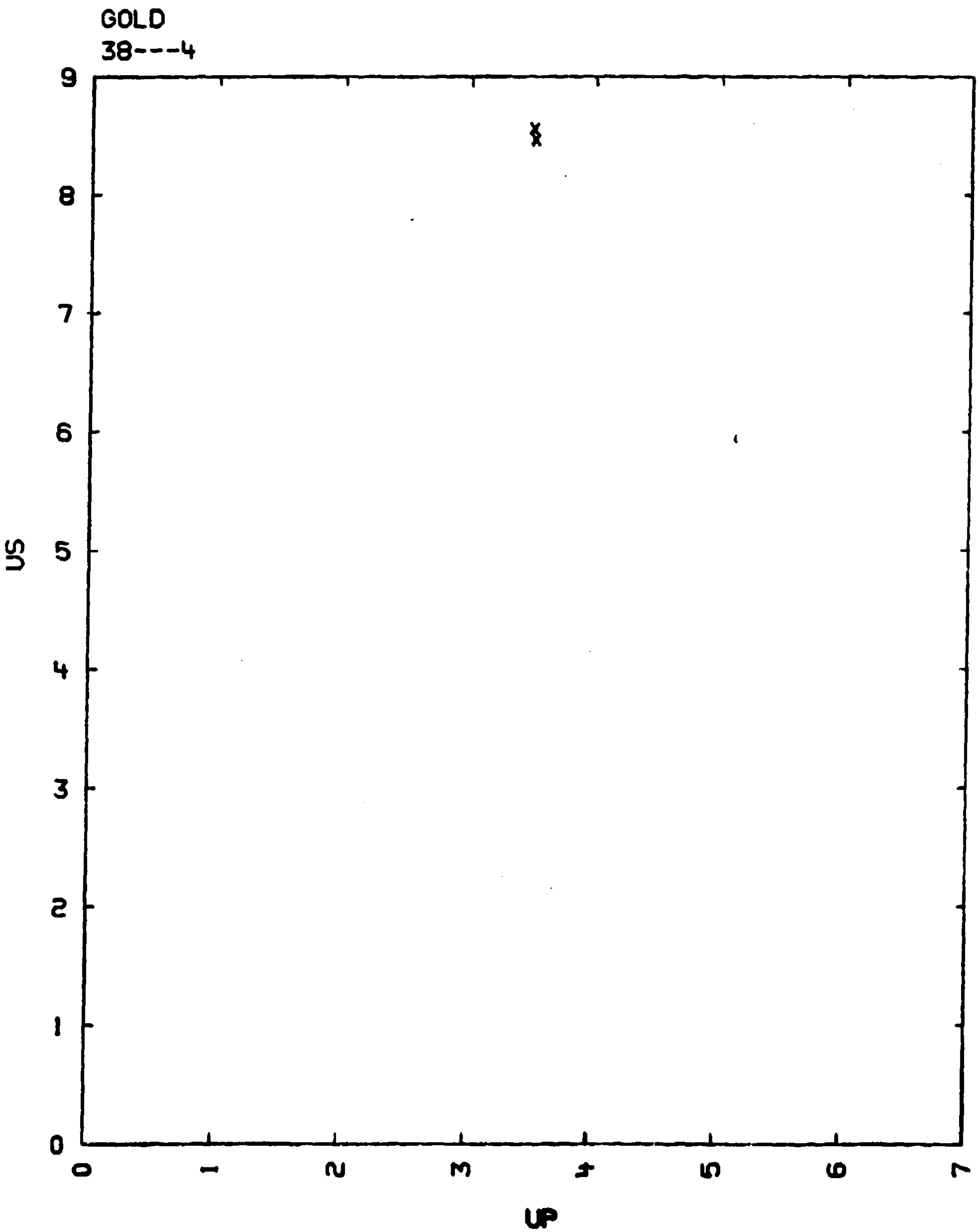
RHOO	US	UP	P	V/VO
19.32	8.46	3.52	5760	0.5854
-	8.55	3.51	5790	0.5895

US =

COMMENTS:

1) SOURCE: JONES, A. H., ISBELL, W. M. AND MAIDEN C. J.
JOURNAL OF APPLIED PHYSICS, VOL. 37, P. 3493 (1966)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE A
STANDARD MATERIAL FANSTEEL 77, SEE MATERIAL 53--39--36---1.
3) THE DRIVER PLATES WERE ACCELERATED BY MEANS OF A LIGHT GAS GUN.
4) THE DRIVER PLATE VELOCITY AND SPATIAL ORIENTATION WAS MEASURED USING TWO PULSE X-RAY STATIONS PRIOR TO IMPACT. THE X-RAY EXPOSURE TIMES WERE 30 NSEC., THE INTERVAL TIME BETWEEN X-RAY PULSES WAS MEASURED ON A 100-MC/SEC COUNTER.
5) FOR BOTH THE DRIVER PLATE IMPACT VELOCITY AND THE SAMPLE SHOCK VELOCITY THE MEASURED EXPERIMENTAL ERROR IS WITHIN 1 PERCENT.
6) VOI WAS TAKEN FROM THE AMERICAN INSTITUTE OF PHYS. HANDBOOK (MCGRAW-HILL BOOK CO. N.Y., 1963) 2ND ED.
7) CO TAKEN FROM CHANG,Y.A. AND HIMMEL,L. J. APPL. PHYS. V.37 3567 1966

TABLE I



39---1
NICKEL

NI 99.7 PERCENT
CO 0.1 PERCENT
MG 0.05 PERCENT
SI 0.05 PERCENT
MN 0.05 PERCENT
FE 0.05 PERCENT

V0 = 0.1129 CC/G. CL = 5.63 KM/SEC. CO = 4.47 KM/SEC.
V01 = 0.1123 CC/G. CS = 2.96 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC. PRESSURE IN KILOBARS, AND DENSITY IN G/CC.

TABLE

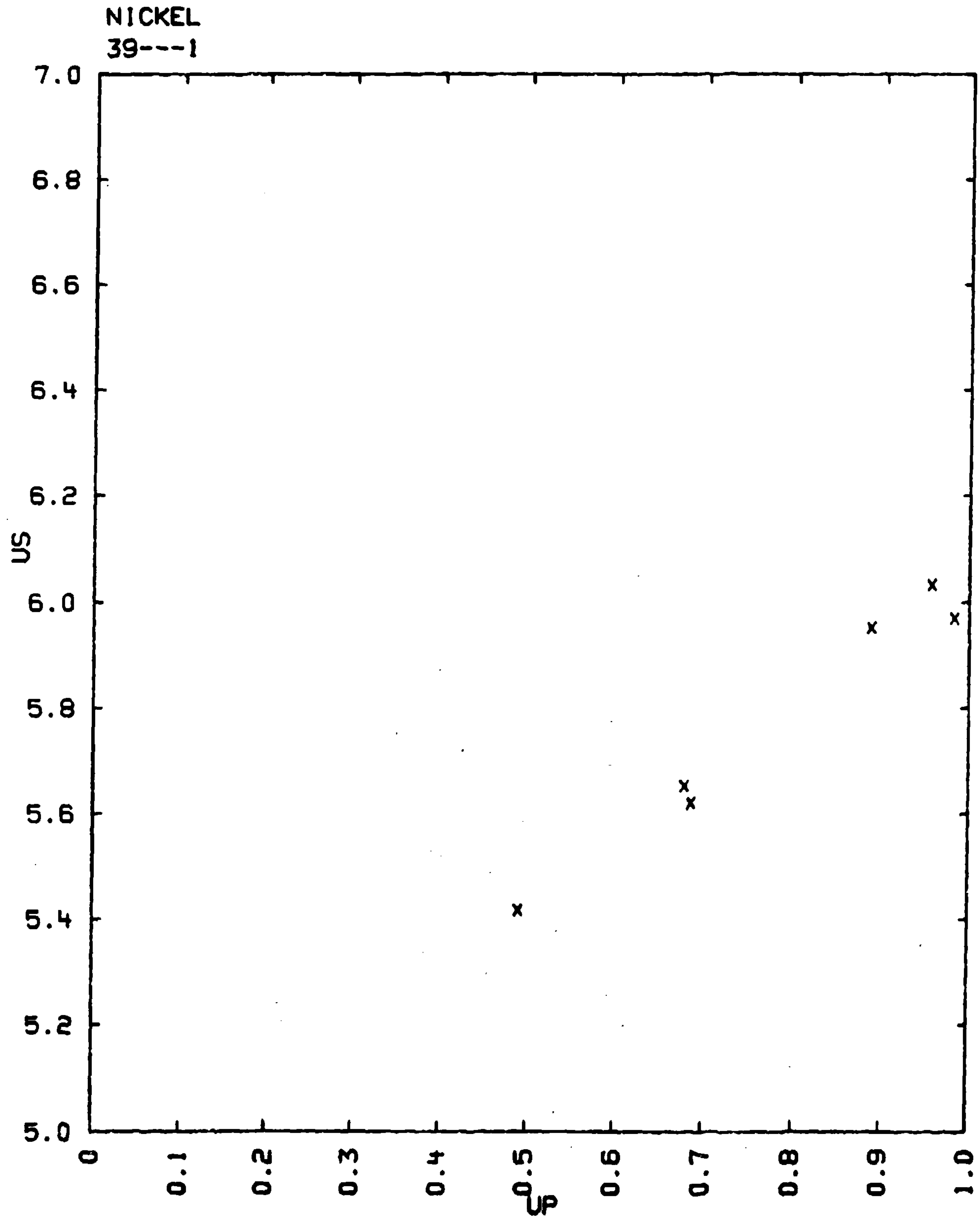
RHOO	US	UFS	UP	P	V1/V0
8.86	5.417	0.981	0.490	235.0	0.9095
-	5.653	1.350	0.678	339.4	0.8801
-	5.620	1.390	0.687	341.8	0.8778
-	6.031	1.955	0.957	511.0	0.8413
-	5.969	1.981	0.982	519.0	0.8355
-	5.952	1.835	0.887	467.4	0.8510

US = 4.796 + 1.254 UP KM/SEC SIGMA US = 0.8 PERCENT

COMMENTS:

1) SOURCE: WALSH, J. M., RICE, M. H., MCQUEEN, R. G. AND YARGER, F. L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 1 PER CENT IN COMPRESSION AT A GIVEN PRESSURE.
4) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS
5) CL AND CS WERE OBTAINED FROM L. BERGMAN, DER ULTRASCHALL, (S. HIRZEL VERLAG, STUTTGART, GERMANY, 1954) 6TH ED., P. 650

TABLE I


NICKEL
39---1
US
UP
7.0
6.8
6.6
6.4
6.2
6.0
5.8
5.6
5.4
5.2
5.0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

39---2
NICKEL

NI

VO = 0.1129 CC/G.
VOI = 0.1123 CC/G.

CO = 4.63 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

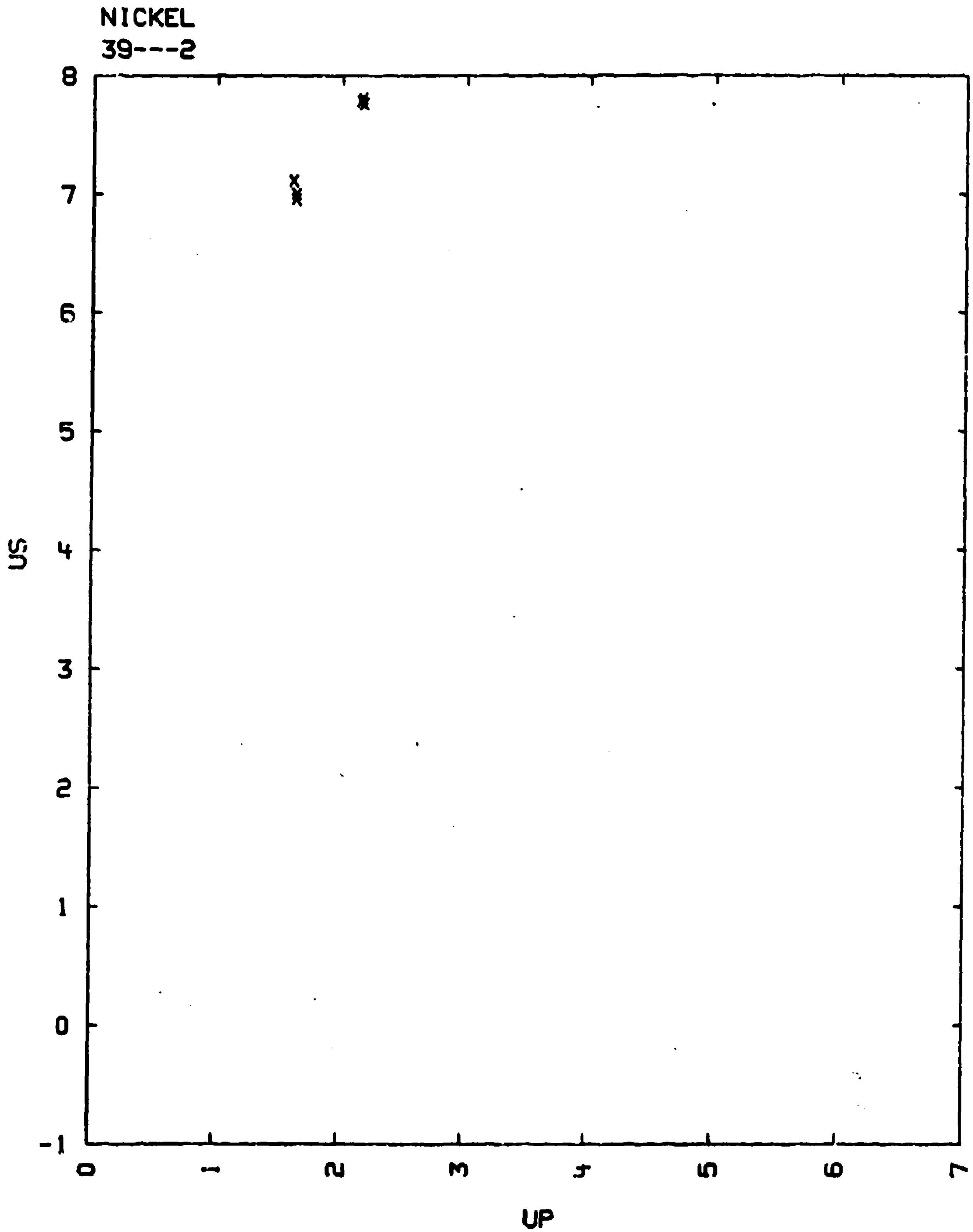
RHOO	US	UP	P	V/VO	PRESSURE IN BRASS STANDARD
8.86	6.95	1.64	1009	0.764	931
-	6.99	1.64	1014	0.766	931
-	7.11	1.62	1022	0.772	931
-	7.78	2.15	1478	0.724	1359
-	7.76	2.17	1491	0.721	1373
-	7.80	2.16	1490	0.723	1368

US = 4.646 + 1.445 UP KM/SEC.   SIGMA US = 0.48 PERCENT

COMMENTS:

1) SOURCE: MCQUEEN, R. G. AND MARSH, S. P.
J. APPL. PHYS., VOL. 31, P. 1253 (1960)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS BRASS
3) FOR THE BRASS STANDARD DATA SEE MATERIAL 38-33
4) VOI WAS TAKEN FROM THE AMERICAN INSTITUTE OF PHYS. HANDBOOK (MCGRAW-HILL BOOK CO. N.Y., 1963) 2ND ED.

TABLE I



39---3
NICKEL

NI

V0 = 0.1129 CC/G.
V0I = 0.1122 CC/G.   CO = 4.573 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC. ST DESIGNATES THE STANDARD MATERIAL USED AS STRIKER (PROJECTILE PLATE). U(ST) = STRIKER VELOCITY BEFORE IMPACT.

TABLE

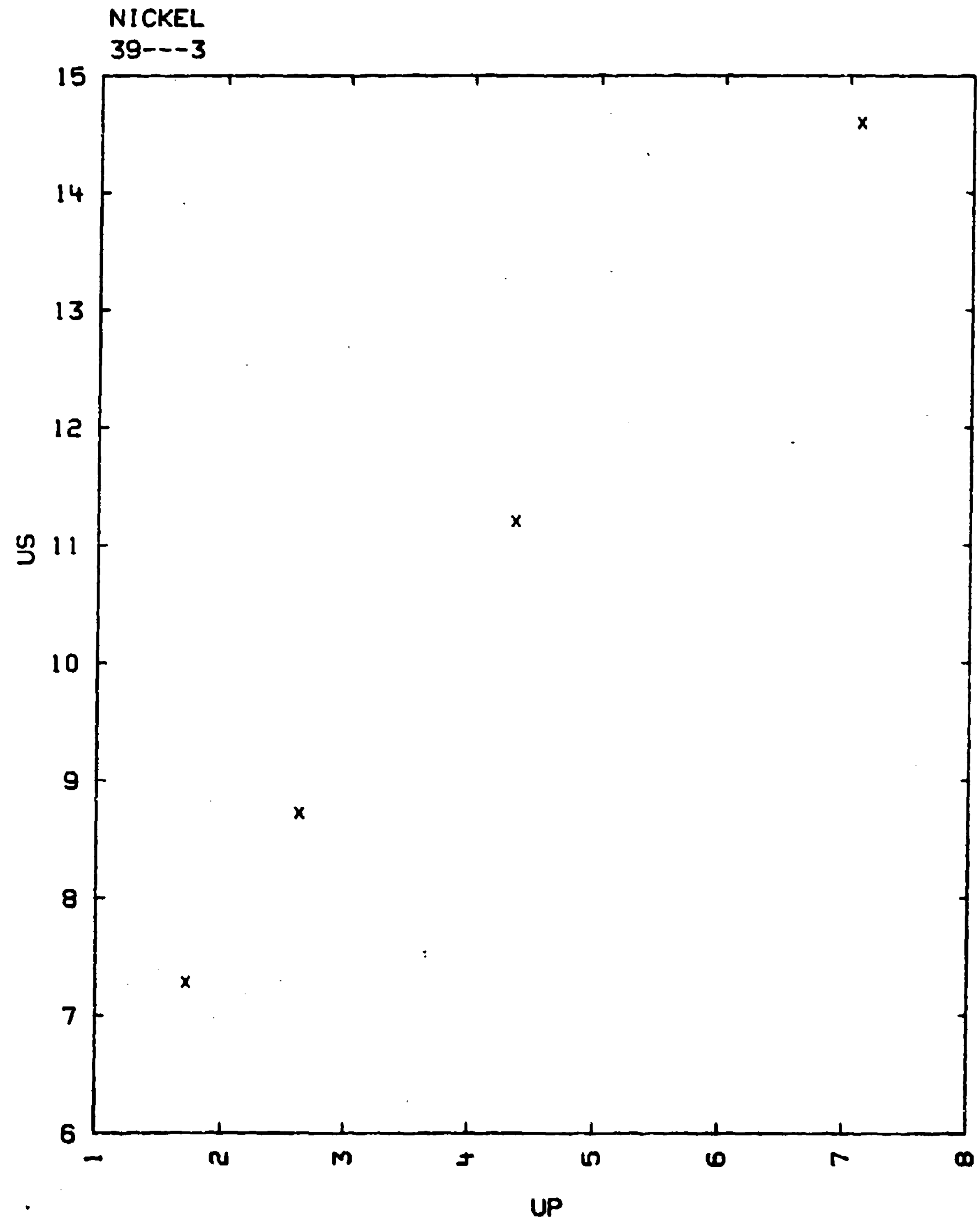
- - - - - - - SAMPLE	- - - - - -				STRIKER	
RHO0	US	UP	P	V/V0	ST	U(ST)
8.86	7.28	1.72	1116	0.7628	AL	5.60
-	8.72	2.63	2033	0.6983	FE	5.60
-	11.20	4.35	4319	0.6120	FE	9.10
-	14.60	7.09	9180	0.5144	FE	14.68

US = 4.370 + 1.775*UP -0.047*UP**2 OR US = 5.099 + 1.355*UP KM/SEC
SIG US = 0.008   SIG US = 0.20

COMMENTS:

1) SOURCE: AL'TSHULER, L.V., BAKANOVA, A.A. AND TRUNIN, R.F.
SOVIET PHYS.-JETP, VOL. 15, P. 65 (1962)
J. EXPTL. THEORET. PHYS. (USSR) VOL. 42, P. 91, (1962)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE A AND B
3) THE UNCERTAINTIES OF THE VALUES IN THE LAST TABLE ENTRY ARE:
1 PERCENT IN US, OBTAINED FROM 6-8 EXPERIMENTS AND 1.5 PERCENT IN U(ST) OBTAINED FROM 12 EXPERIMENTS.
4) V0I WAS OBTAINED FROM THE CUBIC UNIT CELL WITH A = 3.52394 ANGSTROM.
AMERICAN INST. OF PHYS. HANDBOOK (MCGRAW-HILL 1963) 2ND ED
5) CO IS GIVEN BY: K.M. SCHRAMM, Z. METALKUNDE, VOL. 53, P. 729 (1962)

TABLE I



39---4
NICKEL POROUS

NI 99.5 PERCENT
AVERAGE GRAIN SIZE IS 8 MICRONS

VOI = 0.112
VO = 1/RHOO SEE TABLE

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURES IN KILOBARS AND DENSITY IN G/CC. ST DESIGNATES THE STANDARD MATERIAL AND THE MATERIAL OF THE STRIKER PLATE. U IS THE STRIKER VELOCITY BEFORE IMPACT.

TABLE

SAMPLE						DRIVER SYSTEM				
RHOO	US	SIG.US	UP	P	V/VO	ST	U	US	UP	P
6.22	9.79	0.26	.048	2908	0.7331	FE	8.64	10.67	4.26	3568
5.09	9.42	0.18	.051	2469	0.7930	FE	8.64	10.67	4.26	3568
2.97	9.25	0.15	.060	1639	1.0630	FE	8.64	10.67	4.26	3568
8.90	14.87	0.20	.072	9560	0.5139	FE	15.45			
5.09	15.55	0.27	.087	6870	0.7722	FE	15.45			
2.97	15.58	0.27	.101	4670	1.0540	FE	15.45			

US =

COMMENTS:

1) SOURCE: KORMER, S.B., FUNTIKOV, A.I., URLIN, V.D. AND KOLESNIKOVA, A.N. SOVIET PHYS.-JETP, VOL. 15, P. 477 (1962)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE B
3) US IS THE AVERAGE DETERMINATION TAKEN FROM 4-8 EXPERIMENTS, EACH CONSISTING OF 4-6 READINGS.
4) VOI WAS OBTAINED FROM THE HANDBOOK OF CHEMISTRY AND PHYSICS (THE CHEMICAL RUBBER PUBLISHING CO. 1962-1963) 44TH ED.

TABLE I

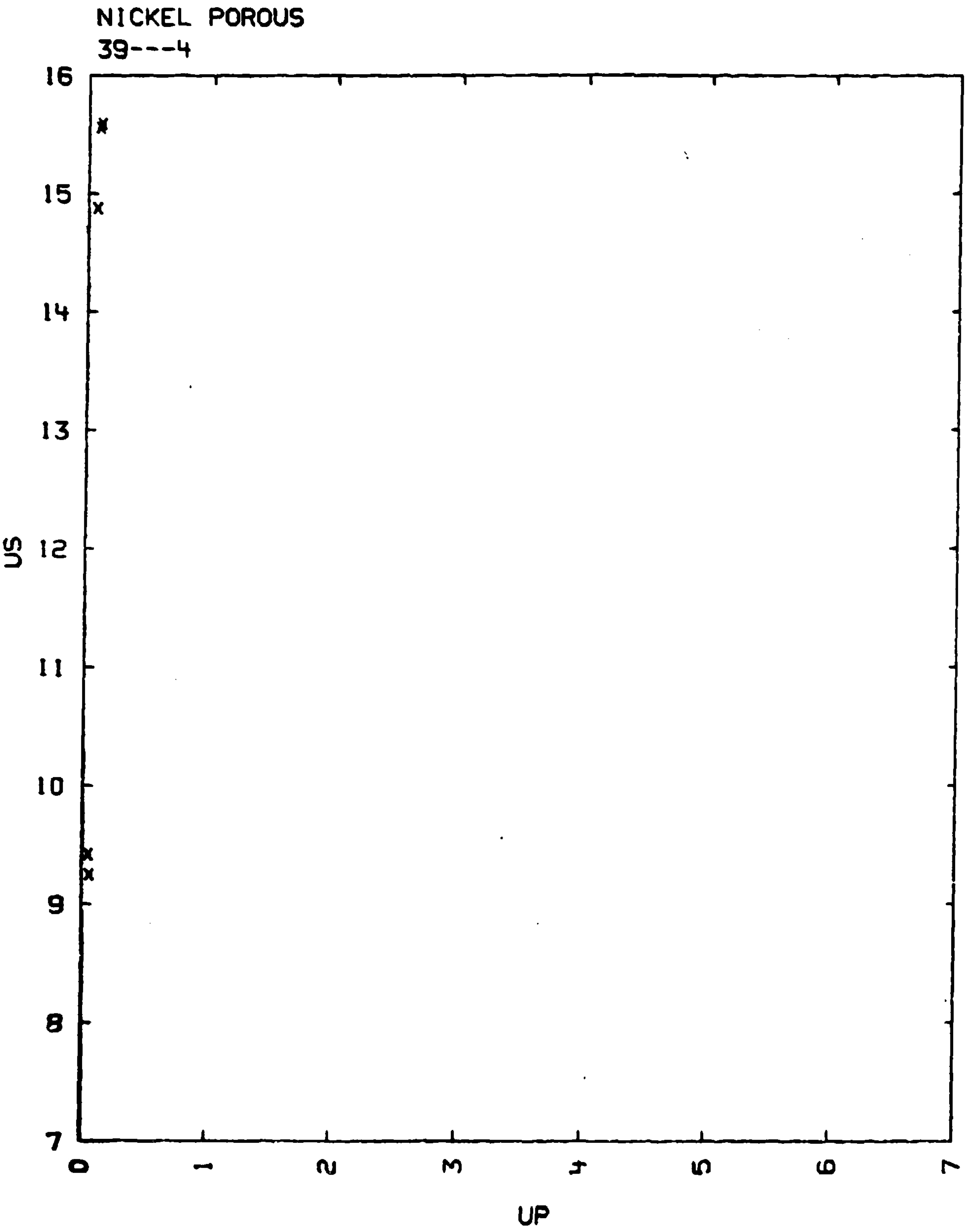
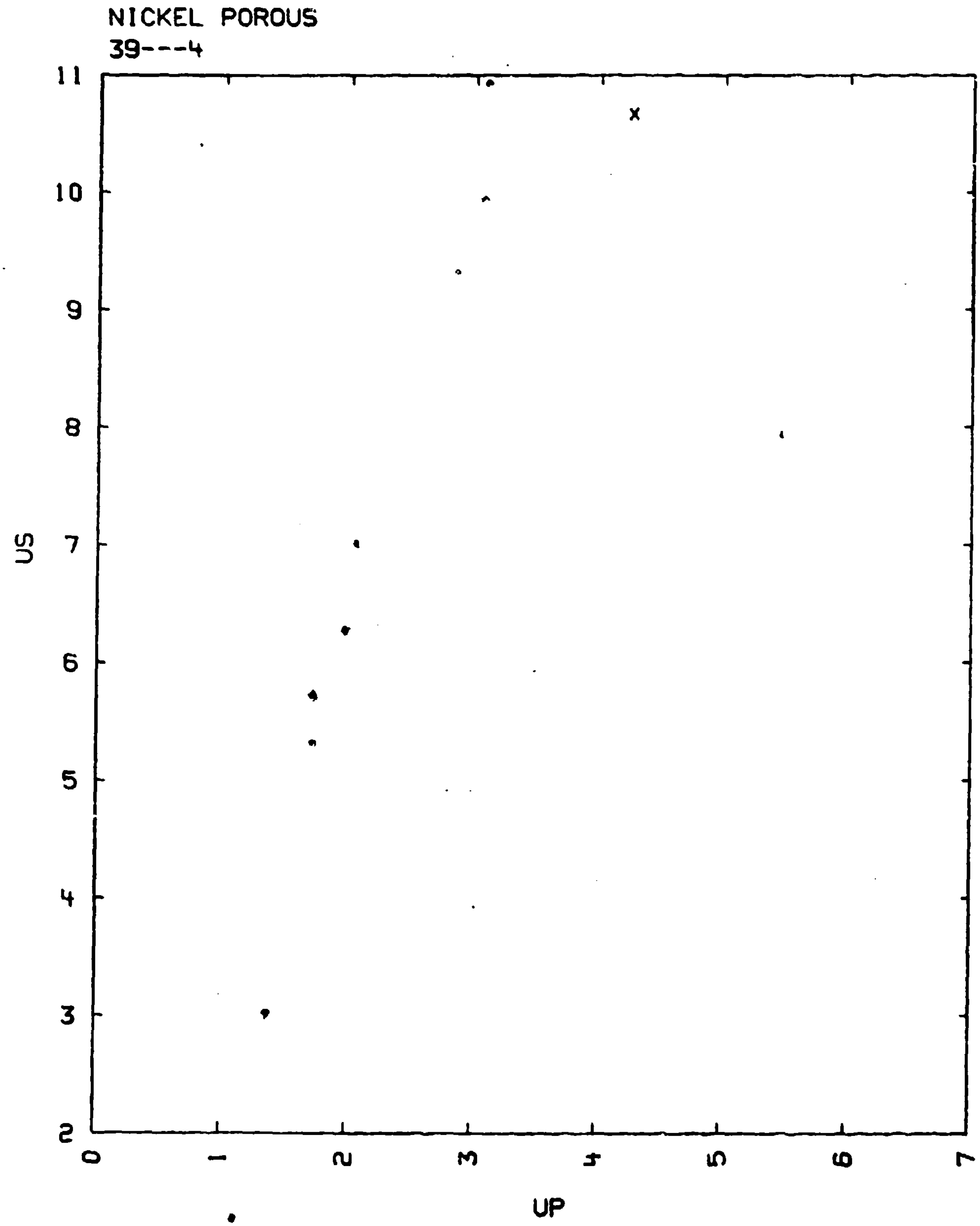


TABLE I



39---5
NICKEL

NI

V0 = 0.1123
V01 = 0.1122

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

-------------SAMPLE				--------------	-STANDARD-
RHO0	US	UP	P	V/V0	UFS
8.905	5.682	0.935	473	0.844	3.040
-	5.834	0.910	472	0.835	3.010
-	5.675	0.898	455	0.842	2.940
-	5.643	0.910	461	0.839	2.970
-	5.598	0.835	417	0.853	2.740
-	5.549	0.815	403.5	0.851	2.675
-	5.586	0.845	419	0.849	2.760
-	5.624	0.840	421	0.851	2.760
-	5.668	0.823	416	0.855	2.725
-	5.668	0.810	410	0.857	2.695
-	5.624	0.815	409	0.855	2.695
-	5.518	0.805	396	0.854	2.635
-	5.488	0.733	358.5	0.866	2.430
-	5.488	0.733	358.5	0.866	2.430
-	5.296	0.780	367	0.850	2.510
-	5.230	0.785	366	0.853	2.510
-	5.411	0.715	345	0.868	2.365
-	5.506	0.715	343	0.870	2.355
-	5.524	0.725	356	0.869	2.415
-	5.393	0.725	348	0.866	2.385
-	5.387	0.657	316	0.878	2.200
-	5.422	0.642	313	0.882	2.175
-	5.549	0.635	313	0.886	2.165
-	5.512	0.635	323	0.880	2.225
-	5.593	0.610	303	0.891	2.100
-	5.330	0.620	295	0.884	2.085
-	5.175	0.635	292	0.877	2.080
-	5.202	0.635	295	0.879	2.100
-	5.000	0.529	235.5	0.894	1.750
-	4.970	0.534	236.5	0.893	1.760
-	5.170	0.520	241	0.899	1.765
-	5.112	0.525	240	0.897	1.765
-	4.931	0.405	178	0.918	1.375
-	5.097	0.401	182	0.921	1.390
-	5.092	0.406	183.5	0.920	1.400
-	4.496	0.370	148	0.918	1.205
-	4.634	0.363	150	0.922	1.205
-	4.617	0.360	149	0.922	1.200
-	4.570	0.365	148	0.920	1.200

NICKEL

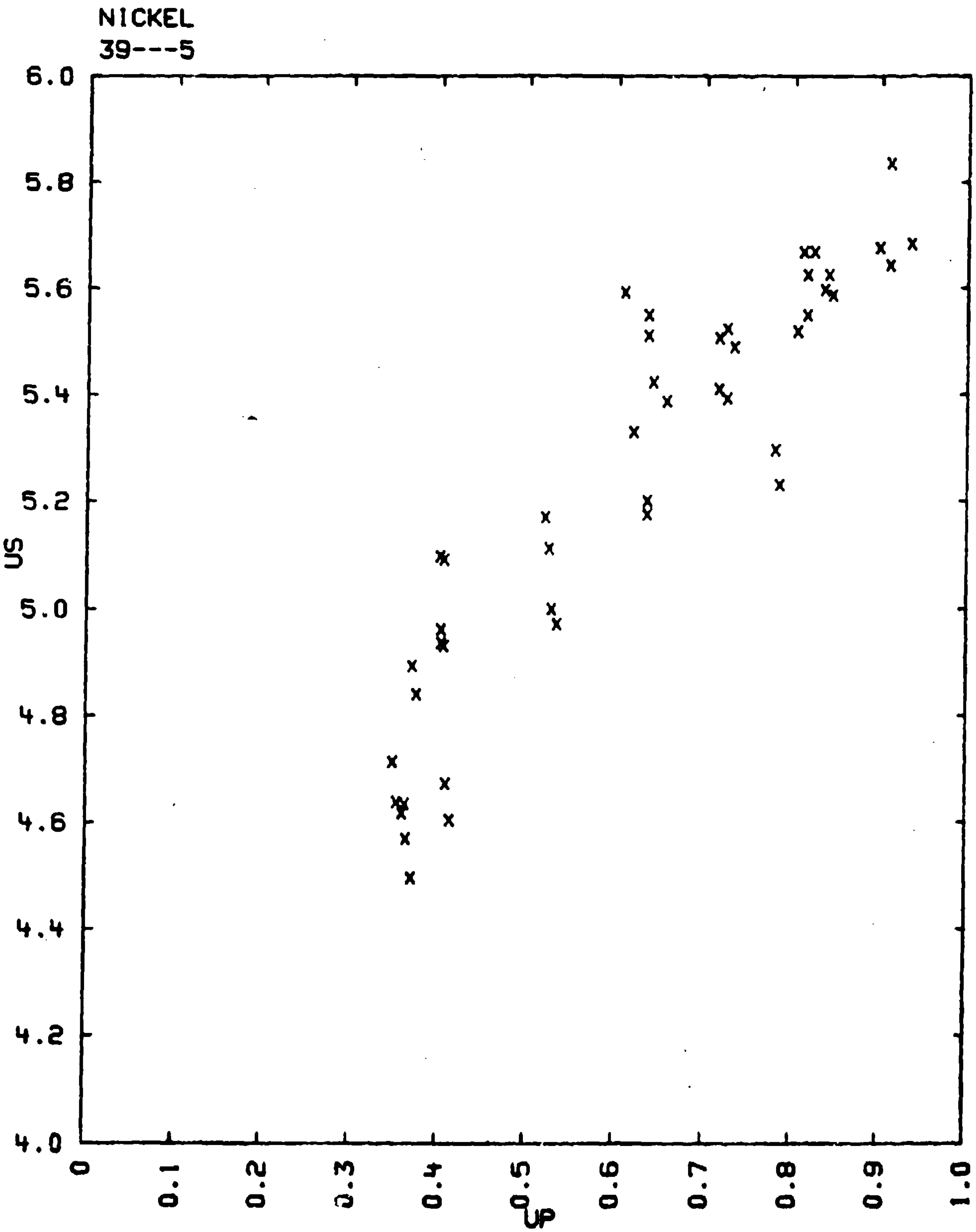
RHOO	US	UP	P	V/VO	UFS
-	4.804	0.413	189.5	0.910	1.345
-	4.873	0.409	170	0.912	1.345
-	4.960	0.403	178	0.919	1.375
-	4.936	0.402	177	0.919	1.385
-	4.840	0.375	161.5	0.923	1.275
-	4.892	0.370	161.5	0.924	1.285
-	4.713	0.349	146.5	0.926	1.175
-	4.638	0.354	146	0.924	1.175

US = 4.119 + 1.806 UP KM/SEC.

COMMENTS:

1) SOURCE: BERGER J. AND FAUQUIGNON C.
PRIVATE COMMUNICATION (1964), B.P. NO. 7, SEVRAN, FRANCE
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL, ALUMINUM AU4G ALLOY
3) VOI WAS OBTAINED FROM THE CUBIC UNIT CELL WITH A = 3.52394 ANGSTROMS.
AMERICAN INSTITUTE OF PHYS. HANDBOOK (MCGRAW-HILL BOOK CO. N.Y., 1963) 2ND ED.
4) SAMPLE DIMENSIONS WERE: 2.0 CM DIAMETER
0.5 CM THICKNESS

TABLE I



NICKEL
39---5
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
US
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP

39---6
NICKEL

NI	99.47	WT. PERCENT
C	0.11	- -
MN	0.26	- -
FE	0.09	- -
S	0.005	- -
SI	0.02	- -
CU	0.02	- -

V0 = 0.1128 CC/G CL = 5.76 KM/SEC CO = 4.53 KM/SEC
CS = 3.08 KM/SEC

THE TABLE LISTS RHO0 IN G/CC, VELOCITIES IN KM/SEC AND P IN KBARS. NI= NICKEL, FS= FANSTEEL AND WF= WEIGHTING FACTOR.

TABLE

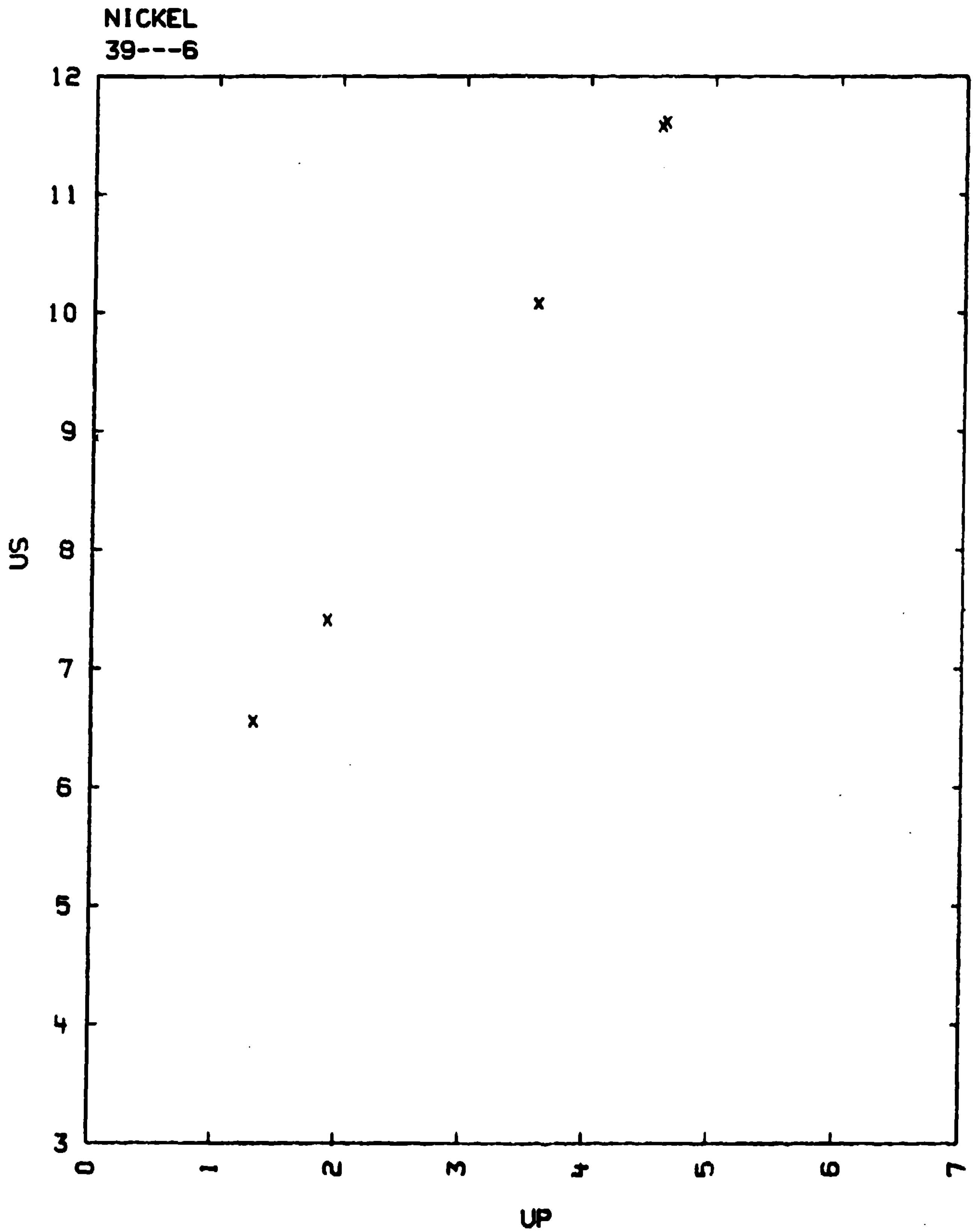
SAMPLE					IMPACTOR		
RHO0	US	UP	P	V/V0	MAT	U	WF
8.864	6.548	1.331	772.	.7967	NI	2.662	3
8.864	7.407	1.919	1260.	.7409	NI	3.839	3
8.864	10.070	3.592	3206.	.6433	NI	7.184	3
8.864	11.572	4.581	4699.	.6041	FS	7.934	1
8.864	11.607	4.616	4749.	.6023	FS	7.993	1

US = 4.456 + 1.555*UP KM/SEC
SIG.US = 0.012 KM/SEC

COMMENTS:

1) SOURCE: ISBELL W.M., SHIPMAN F.H. AND JONES A.H.
HUGONIOT EQUATION OF STATE OF ELEVEN MATERIALS TO FIVE MBARS
MATERIALS SCIENCE LABORATORY REPORT: MSL-68-13
2) EXPERIMENTAL TECHNIQUE: A
DATA REDUCTION METHOD : A
3) NOMINAL UNCERTAINTIES ARE: (SIG.US)/US = .005 AND (SIG.U)/U = .0005
4) ALSO GIVEN: POISSONS RATIO 0.30 , YIELD STRENGTH 5.69 KBAR
TENSILE - 6.14 KBAR

TABLE I



40---1
COBALT

CO 99.45 PERCENT
NI 0.5
OTHER 0.05 -

VO = 0.1133 CC/G
VOI = 0.1138 CC/G

IN THE TABLE BELOW DENSITY IS GIVEN IN G/CC VELOCITY IN KM/SEC. AND PRESSURE IN KILOBARS.

TABLE

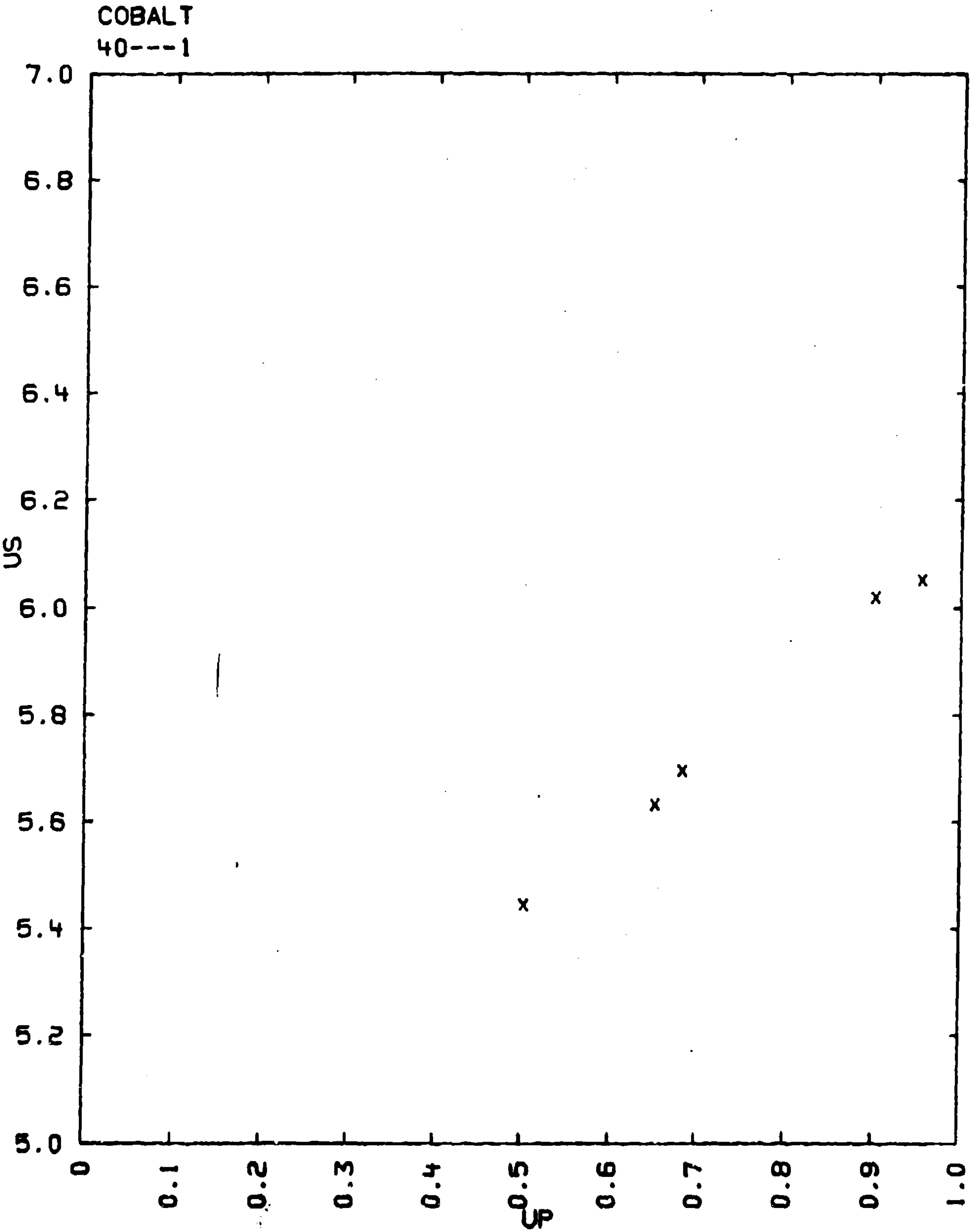
RHOO	US	UFS	UP	P	V/VO
8.82	5.445	1.016	0.502	241.1	0.9078
-	5.606	1.327	0.683	343.2	0.8801
-	5.632	1.334	0.653	324.4	0.8841
-	6.019		0.901	478.1	0.8503
-	6.052	1.890	0.955	509.8	0.8422

US = 4.740 + 1.392UP KM/SEC SIGMA US = 0.020

COMMENTS:

1) SOURCE: WALSH, J.M., RICE, M.H., MCQUEEN, R.G. AND YARGER, F.L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
3) STANDARD MATERIAL: 24ST ALUMINUM
4) THE IMPURITES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS
5) VOI WAS OBTAINED FROM THE AMERICAN INSTITUTE OF PHYS. HANDBOOK
(MCGRAW-HILL BOOK CO. N.Y., 1963) 2ND ED.

TABLE I


COBALT
40---1
US
UP
7.0
6.8
6.6
6.4
6.2
6.0
5.8
5.6
5.4
5.2
5.0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

40---2
COBALT

CO

VO = 0.113 CC/G.
VOI = 0.1138 CC/G.

CB = 4.63 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURES IN KILOBARS AND DENSITY IN G/CC.

TABLE

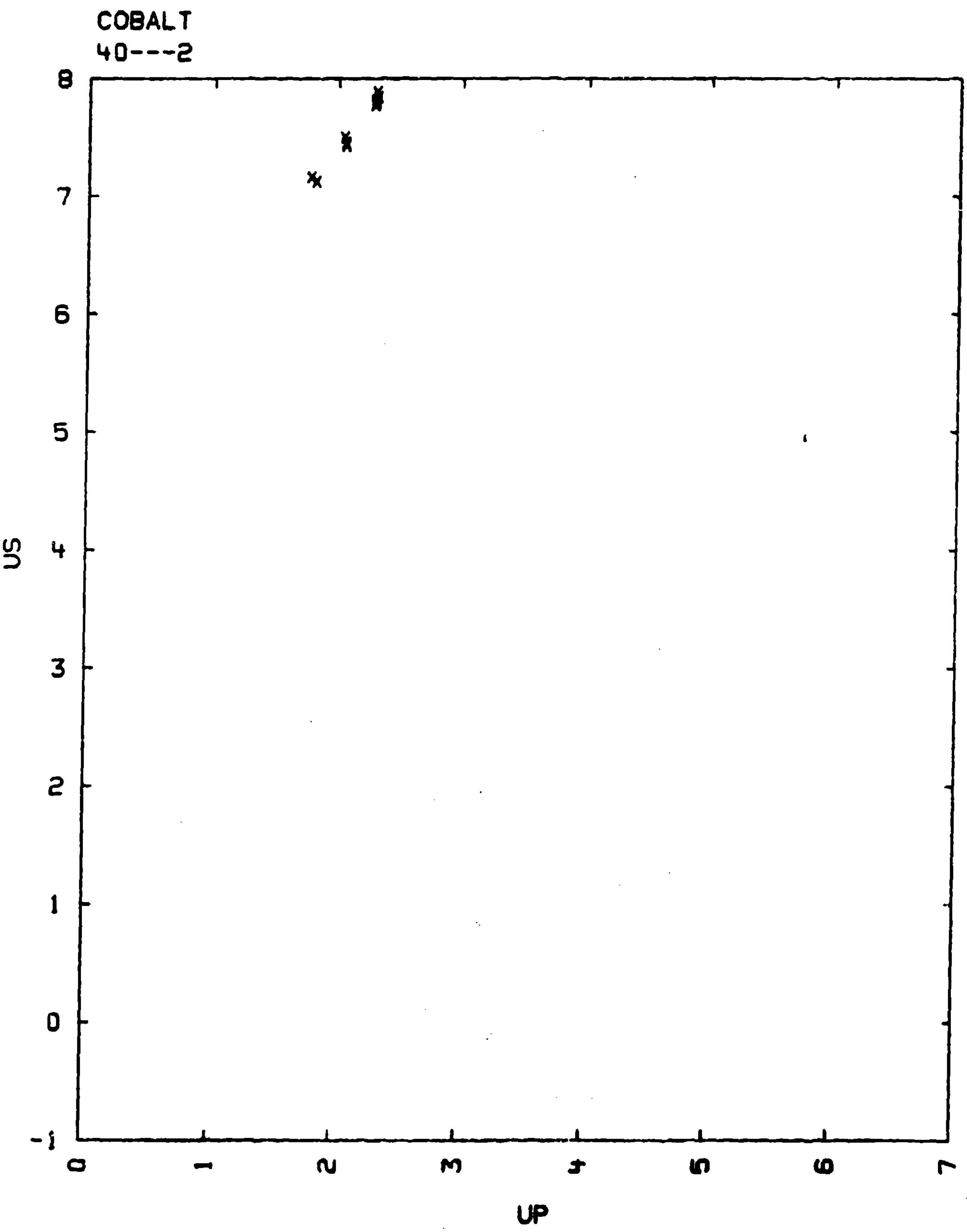
RHOO	US	UP	P	V/VO	PRESSURE IN BRASS STANDARD
8.82	7.15	1.79	1121	0.750	1038
-	7.15	1.80	1137	0.748	1050
-	7.12	1.83	1148	0.743	1064
-	7.50	2.06	1362	0.726	1267
-	7.45	2.07	1358	0.723	1267
-	7.43	2.07	1357	0.721	1267
-	7.81	2.30	1584	0.706	1478
-	7.79	2.30	1581	0.705	1478
-	7.77	2.30	1577	0.703	1478
-	7.88	2.31	1608	0.707	1497
-	7.83	2.32	1603	0.703	1497

US = 4.748 + 1.330 UP KM/SEC.   SIGMA US = 0.46 PERCENT

COMMENTS:

1) SOURCE: MCQUEEN, R. G. AND MARSH, S. P.
J. APPL. PHYS., VOL. 31, P. 1253 (1960)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS BRASS
3) FOR THE BRASS STANDARD DATA SEE MATERIAL 38-33
4) VOI WAS TAKEN FROM THE A. I. P. AHNDBOOK (MCGRAW HILL BOOK CO.)
2ND ED.

TABLE I



41---0
IRON SUMMARY

FE 99.99 TO 98.5 PERCENT BY WT.

V0 = 0.1272 - 0.1277 CC/G CL = 5.960 KM/SEC C0 = 4.64 KM/SEC.
V0I= 0.1269 CC/G CS = 3.240 KM/SEC

THE TABLE LISTS THE HUGONIOT POINTS CALCULATED FROM THE FITS GIVEN BELOW
UNITS ARE G/CC, KM/SEC, KBAR AND KBAR.CC/G FOR THE ENERGY DIFFERENCE.
EL = ELASTIC LIMIT, TP = TRANSITION POINT.

TABLE

FIT	RHO0	US	UP	P	V/V0	E-E0	COMMENTS		
1	7.85	6.00	0.015	7.1	0.9975	0.0011	EL	1ST	WAVE
1	-	6.00	0.022	10.4	0.9963	0.0024	-	-	-
2	-	5.000	0.10	40.9	0.9807	0.0534		2ND	-
2	-	5.045	0.20	80.8	0.9610	0.207		-	-
2	-	5.091	0.30	121.	0.9417	0.459		-	-
2	-	5.101	0.323	131.	0.9373	0.533	TP	-	-
3	-	3.337	.34	135.	0.9320	0.617		3RD	-
3	-	3.565	.40	152.	0.9150	0.910		-	-
3	-	4.323	.60	224.	0.8724	1.908		-	-
3	-	5.081	.80	321.	0.843	3.077		-	-
4	-	5.404	1.0	425.	0.815	5.03		2ND	-
4	-	7.106	2.0	1116.	0.718	20.0		1ST	WAVE
4	-	8.741	3.0	2058.	0.657	45.0		-	-
4	-	10.310	4.0	3237.	0.612	80.0		-	-
4	-	13.248	6.0	6240.	0.547	180.		-	-
4	-	15.920	8.0	9997.	0.497	320.		-	-

US = 6.0 KM/SEC +OR- 0.1 KM/SEC (FOR FIT 1)
FOR UP BETWEEN .022 KM/SEC.
US = 4.955 + 0.454*UP, SIG.US = .05 KM/SEC (FOR FIT 2)
FOR UP BETWEEN .1 AND .33 KM/SEC.
US = 2.049 + 3.79 *UP, SIG.US = .09 KM/SEC (FOR FIT 3)
FOR UP BETWEEN .34 AND .79 KM/SEC.
US = 3.635 + 1.802*UP - .0333*UP**2, (FOR FIT 4)
SIG.US = .13 KM/SEC
FOR UP BETWEEN 1.0 AND 7.7 KM/SEC

COMMENTS

1) SOURCE: COMPILER
1A) DATA FOR THESE FITS WERE TAKEN FROM 41---1,2,3,4,5,7,8,10,11,12
AND 14
2) 41---1 SHOWS THAT THE ELASTIC WAVE STRENGTH DEPENDS ON THICKNESS.

THE TWO VALUES LISTED WERE OBTAINED ON 50 AND 6 MM. SAMPLES RESPECTIVELY. THE 2ND AND HIGHEST ELASTIC LIMIT WAS USED TO CALCULATE P, V/VO AND E-EO FOR 2ND WAVES IN THE MULTIPLE WAVE REGION OF THE HUGONIOT. 6.0 KM/SEC WAS TAKEN AS THE BEST AVERAGE WAVE VELOCITY.

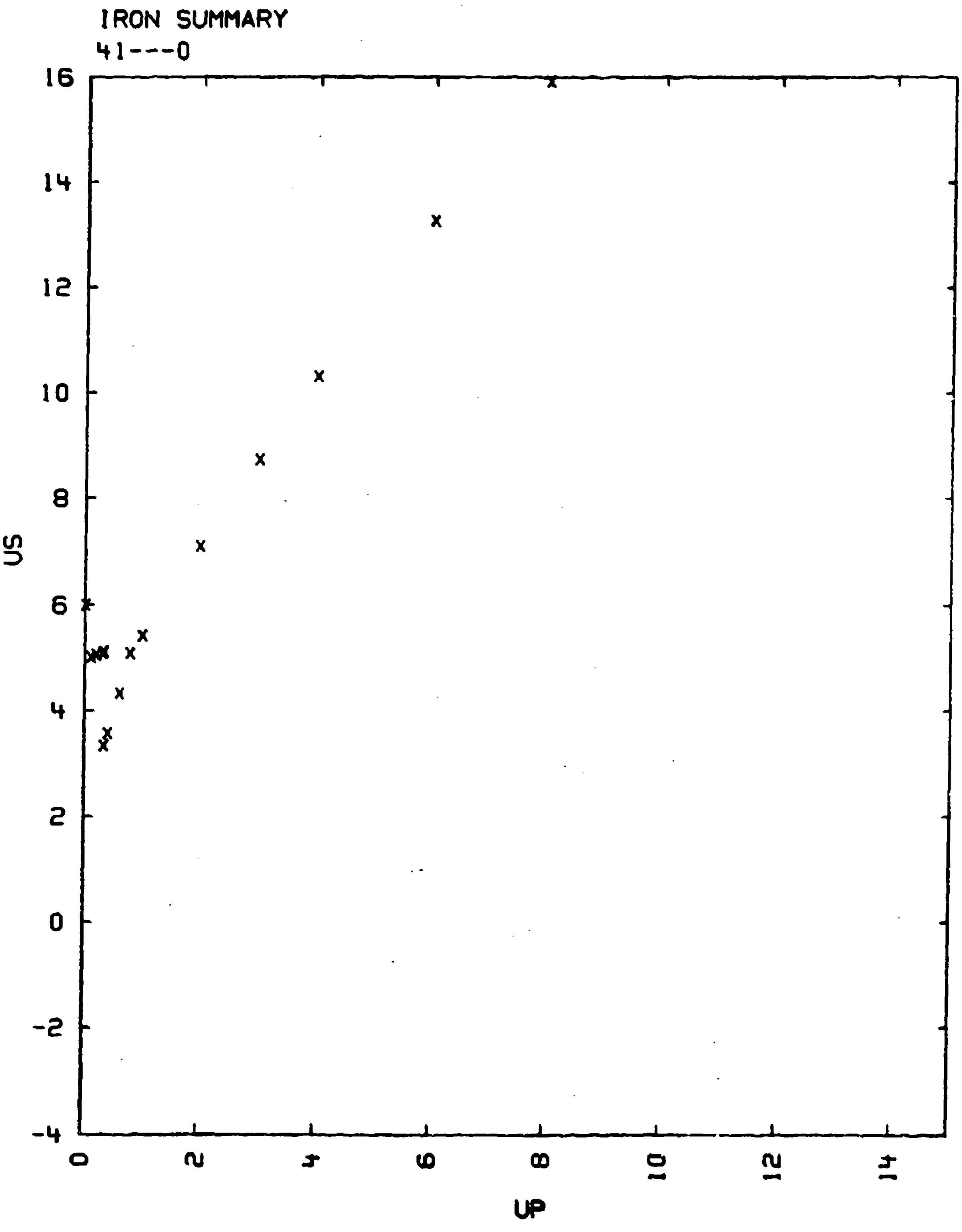
3) THE 41---1 SOURCE ALSO SHOWED THAT THE 2ND WAVE WAS BROAD, ESPECIALLY FOR SMALL AMPLITUDES. POINTS WITH UP LESS THAN .08 WERE THEREFORE ELIMINATED. FIT 2 WAS MADE FROM DATA OF 41---1,5,10,11,12 AND 14.

4) THE FINAL PORTION OF THE HUGONIOT CURVE ABOVE THE TRANSITION (HERE TAKEN AS 131 KBAR) IS GIVEN IN TWO PARTS. DATA OF 41---14 SHOW A HIGHER SLOPE AT LOW PRESSURES IN THE MULTIPLE WAVE REGION. IN THIS REGION, MINSHALLS DATA SHOW 10-PERCENT LOWER SHOCK VELOCITIES. THE DATA OF MINSHALL (41---5,10,11 AND 12) SUGGEST THAT THE TRANSITION WAVE STRENGTH DEPENDS ON SAMPLE THICKNESS.

5) FIT 4 WAS OBTAINED FROM 41---3,4 AND 7 WITH A WEIGHT OF 2 AND 41---2,8 WITH A WEIGHT OF 1.

6) CO WAS TAKEN FROM THE AMERICAN INSTITUTE OF PHYSICS HANDBOOK (MCGRAW HILL BOOK CO., N. Y., 1963) 2ND ED. C. A. ROTTER AND C. S. SMITH MEASURED CO = 4.606 KM/SEC. (J. PHYS. CHEM. SOLIDS, V. 27, P. 267 (1966)).

TABLE I



41---1
IRON ARMCO

FE

V0 = .1274 CC/G CL = 5.960 KM/SEC C0 = 4.64 KM/SEC.
V01= 0.1269 CC/G CS = 3.240 KM/SEC

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN MM/MICRO-SEC, PRESSURE IN KILOBARS AND SAMPLE THICKNESS (LS) IN MM.

TABLE

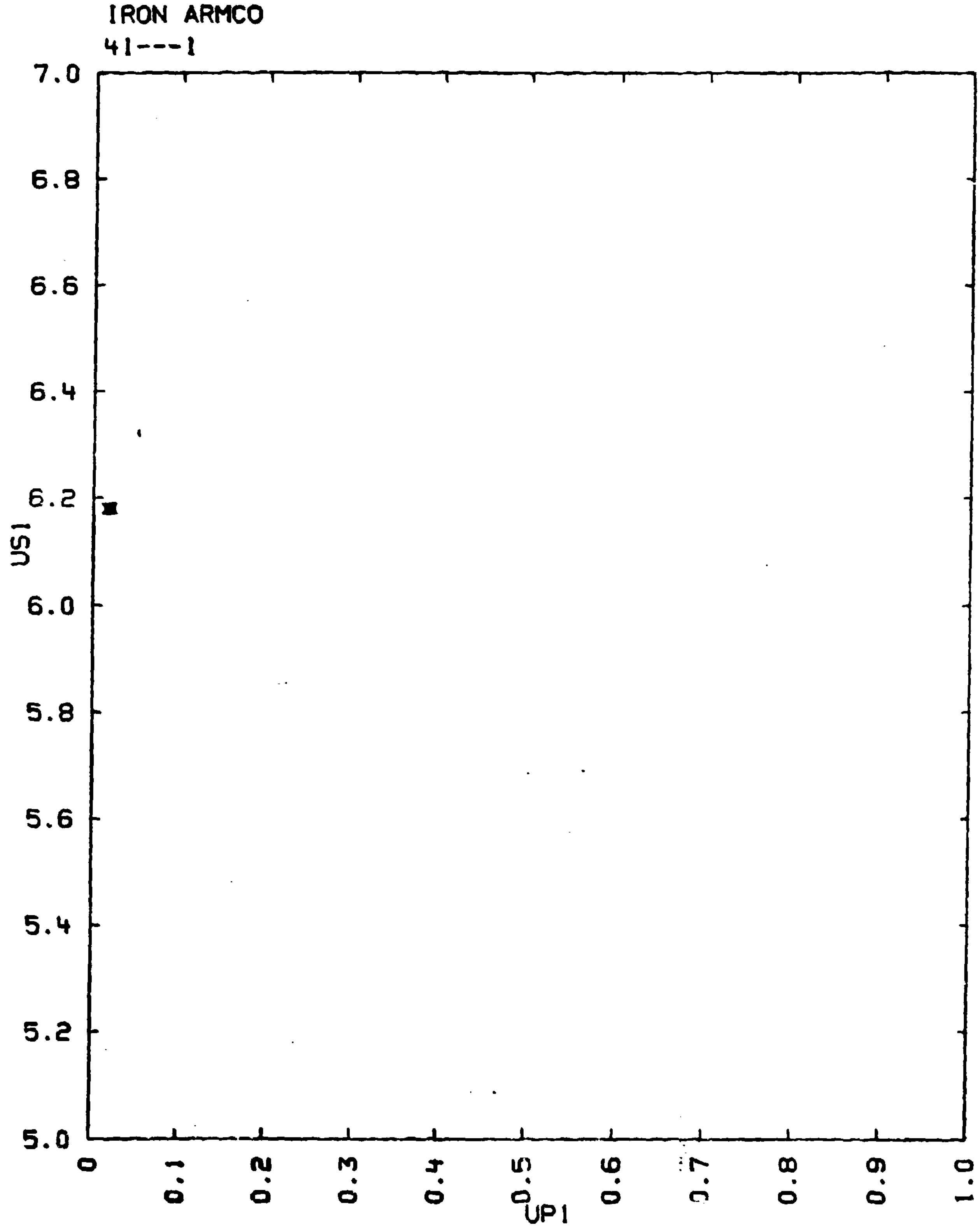
RHO0	US1	UP1	P1	V1/V0	US2	UP2	P2	V2/V0	LS
7.85	6.18	.015	7.28	.9976	5.08	.1935	78.4	.9625	50.8
-	6.18	.015	7.28	.9976	4.88	.0848	34.0	.9833	-
-	6.18	.015	7.28	.9976	4.91	.1080	43.1	.9786	-
-	6.18	.017	8.25	.9972	4.95	.096	39.3	.9812	25.4
-	6.18	.017	8.25	.9972	4.69	.060	24.1	.9880	-
-	6.18	.017	8.25	.9972	5.05	.186	75.2	.9637	-
-	6.18	.0195	9.46	.9968	5.08	.1805	73.6	.9651	12.7
-	6.18	.0195	9.46	.9968	4.65	.0770	30.4	.9844	-
-	6.18	.0195	9.46	.9968	4.17	.0310	13.2	.9946	-
-	6.18	.022	10.67	.9964	4.65	.079	31.5	.9841	6.35
-	6.18	.022	10.67	.9964	5.06	.192	75.9	.9639	-
-	6.18	.022	10.67	.9964	4.98	.130	52.9	.9747	-
-	6.18	.022	10.67	.9964	4.98	.192	75.7	.9622	-

US =

COMMENTS:

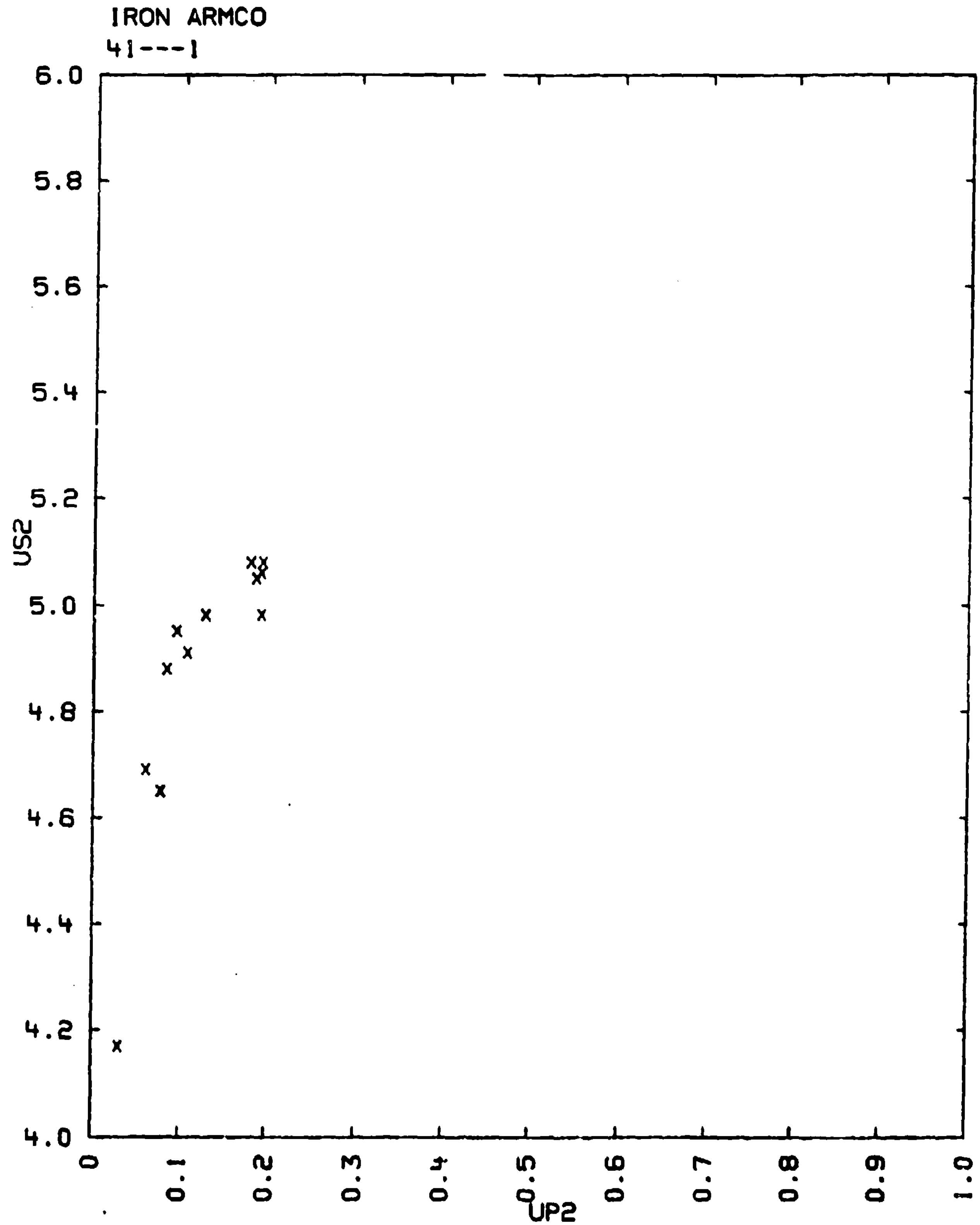
1) SOURCE: TAYLOR, JOHN W. AND RICE, M.H.
J. APPL. PHYS., VOL. 34, P. 364 (1963)
2) EXPERIMENTAL TECHNIQUE G
DATA REDUCTION TECHNIQUE A
THE SHOCK WAS DRIVEN INTO THE SAMPLE BY AN ARMCO PLATE, BACKED BY AN ALUMINUM PROJECTILE, WHICH WAS FIRED FROM A 6.5 INCH GUN.
3) A CAPACITOR TECHNIQUE MEASURED SHOCK ARRIVAL AND FREE SURFACE VELOCITY. PINS WERE USED TO MEASURE PROJECTILE VELOCITY.
4) CL AND CS WERE OBTAINED FROM THE AMERICAN INSTITUTE OF PHYS. HANDBOOK (MCGRAW-HILL BOOK CO. N.Y., 1963) 2ND ED.
5) PROJECTILE VELOCITY WAS EQUAL TO THE FREE SURFACE VELOCITY TO WELL WITHIN THE ACCURACY OF THE EXPERIMENT (2 PERCENT).
6) NOTE THAT US2 = V0((P2-P1)/(V1-V2))**(1/2)

TABLE I



IRON ARMCO
41---1
7.0
6.8
6.6
6.4
6.2
6.0
5.8
5.6
5.4
5.2
5.0
US1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP1

TABLE I


IRON ARMCO
4I---I
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
US2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP2

41---2
STEEL MILD, EN3

IRON	FE	98.75 PERCENT
CARBON	C	.25 PERCENT
MANGANESE	MN	1.00 PERCENT

V0 = 0.1275 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN MM/MICRO-SEC, AND PRESSURE IN KILOBARS.

TABLE

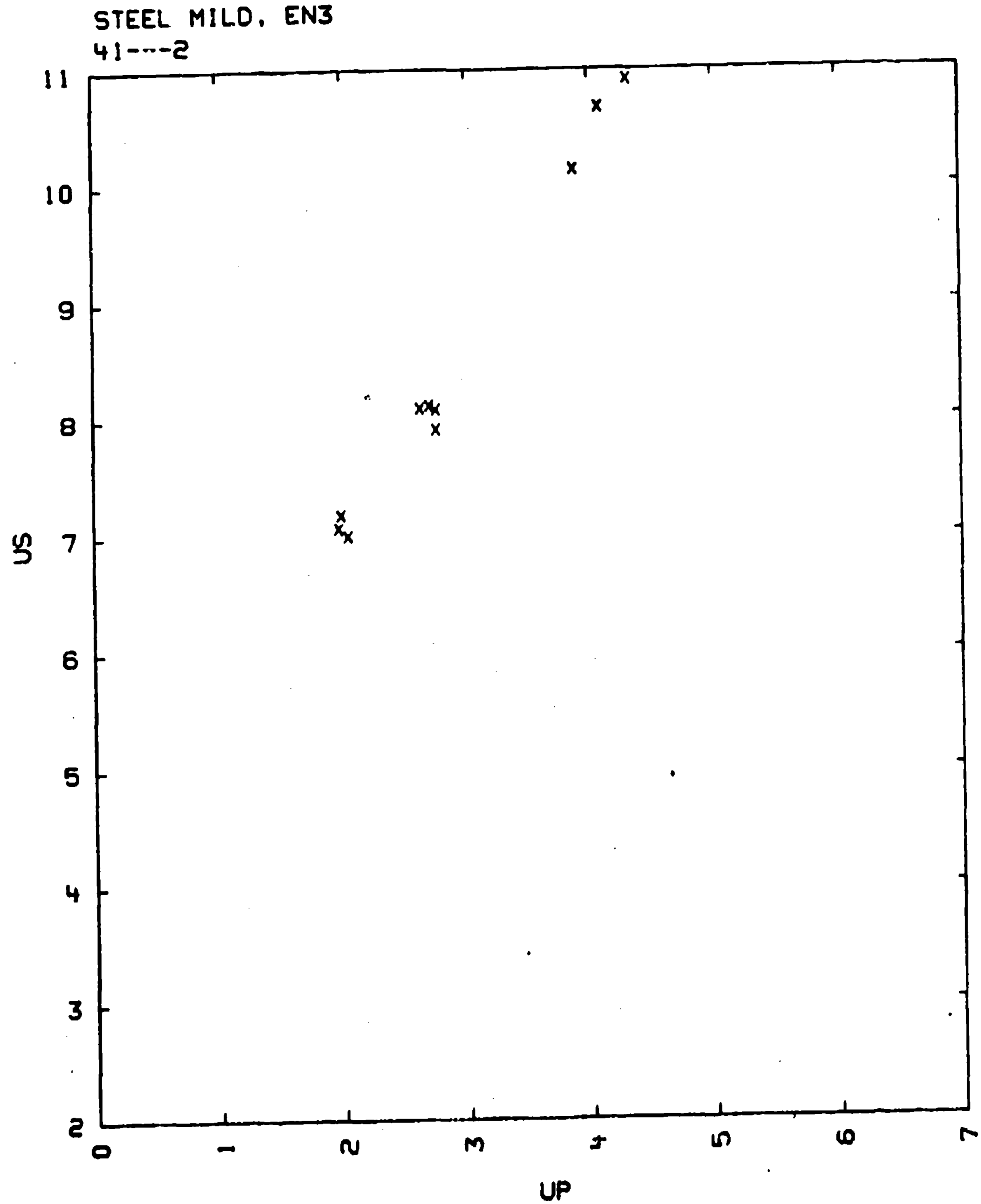
RHO0	US	UP	P	V/V0
7.84	7.06	1.97	1090	.721
-	7.18	1.99	1120	.723
-	6.99	2.05	1120	.707
-	8.08	2.63	1670	.675
-	7.90	2.75	1700	.652
-	8.11	2.70	1720	.667
-	8.07	2.75	1740	.659
-	10.13	3.88	3090	.617
-	10.66	4.09	3420	.616
-	10.90	4.32	3700	.604

US = 3.67 + 1.645 UP KM/SEC. SIG.US = 0.18 KM/SEC

COMMENTS:

1) SOURCE: SKIDMORE, I.C. AND MORRIS, E.
THERMODYNAMICS OF NUCLEAR MATERIALS, P. 173 FF. (1962)
INTERN. AT. ENERGY AGENCY, VIENNA
ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON, ENGLAND
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE A
IN THE EXPERIMENTS, EXPLOSIVELY ACCELERATED PLATES OF THE ABOVE MATERIAL WERE IMPACTED WITH TARGET PLATES OF THE SAME MATERIAL WHICH CONTAINED THE SAMPLES.
3) THE VELOCITY OF THE FLYING PLATE AND THE SHOCK AND SURFACE VELOCITY OF THE TARGET PLATE WERE MEASURED AS WELL AS THE SAMPLE SURFACE AND SHOCK VELOCITIES.
4) DATA SCATTER WAS ABOUT 0.03 MICROSEC.
5) CORRECTIONS WERE MADE FOR FLYING PLATE CURVATURE OF UP TO 1 MICROSEC.
6) THE HIGHER PRESSURES WERE OBTAINED BY A SPHERICALLY CONVERGING SYSTEM.
7) ALL PELLETS WERE SURROUNDED BY LEAD TO REDUCE LATERAL RAREFACTION.

TABLE I



41---3
IRON

FE 99.8 PER CENT OR GREATER

VO = 0.1278 CC/G. CL = 5.85 KM/SEC. CO = 4.51 KM/SEC.
VOI = 0.1271 CC/G. CS = 3.23 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC. PRESSURE IN KILOBARS, AND DENSITY IN G/CC.

TABLE

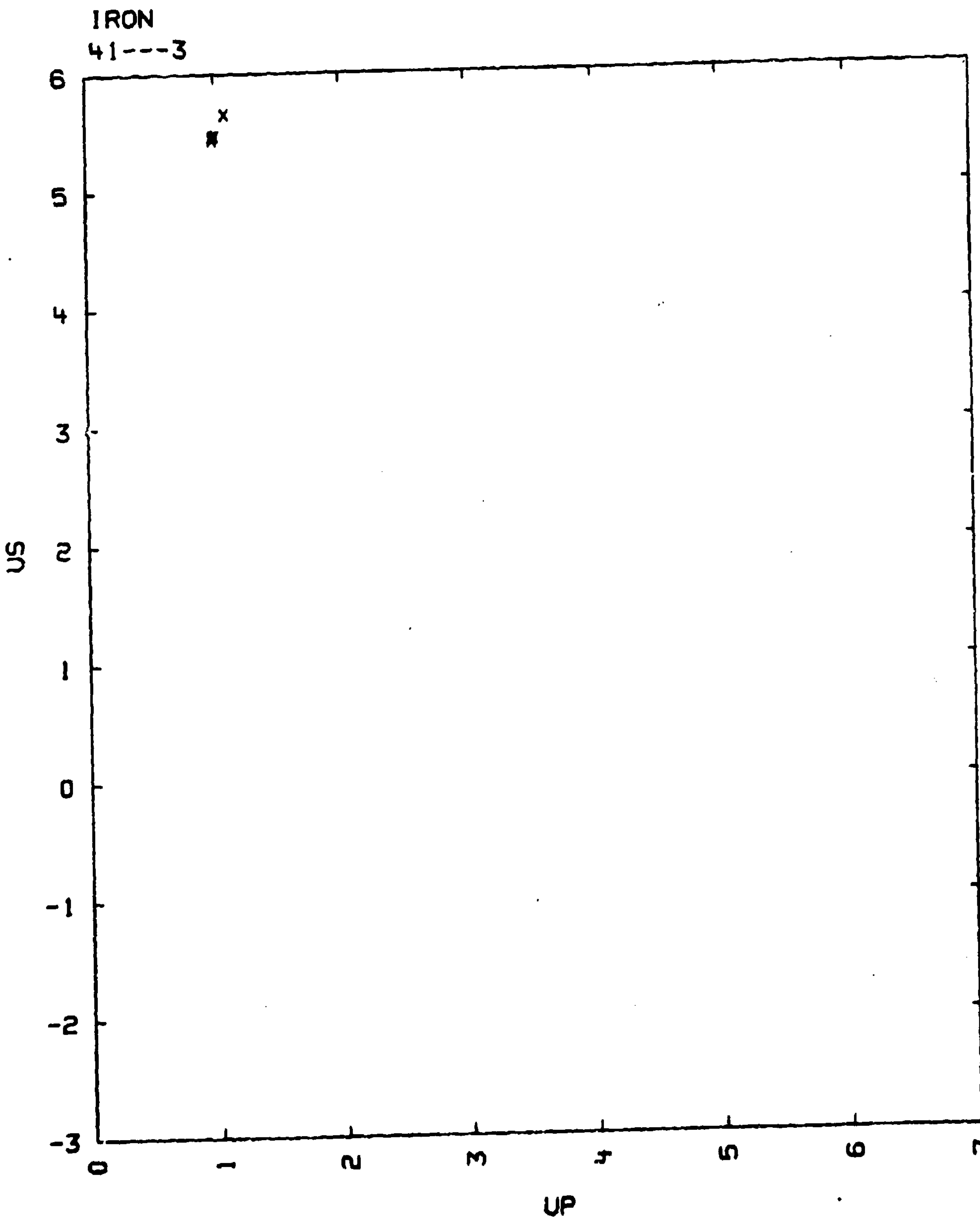
RHOO	US	UFS	UP	P	V/VO
7.84	5.652	2.183	1.085	480.8	0.8080
-	5.474	2.037	1.013	434.7	0.8149
-	5.458	1.988	0.993	424.9	0.8181
-	5.438	2.005	0.994	423.8	0.8172

US = 3.205 + 2.252 UP KM/SEC SIGMA US = 0.3 PERCENT

COMMENTS:

1) SOURCE: WALSH, J. M., RICE, M. H., MCQUEEN, R. G. AND YARGER, F. L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 1 PER CENT IN COMPRESSION AT A GIVEN PRESSURE.
4) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS.
5) CL AND CS VALUES WERE OBTAINED FROM L. BERGMAN, DER ULTRASCHALL S. HIRZEL VERLAG, STUTTGART, 1954, 6TH ED., P. 650
6) VOI WAS TAKEN FROM THE A. I. P. HANDBOOK (MCGRAW HILL BOOK CO.) 2ND ED.

TABLE I



41---4
IRON

FE

V0 = 0.1272 CC/G CL = 5.95 KM/SEC. C0 = 4.627 KM/SEC.
V0I = 0.1271 CC/G. CS = 3.240 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC.
PRESSURES IN KILOBARS AND DENSITY IN G/CC.

TABLE

SAMPLE					STANDARD		
RHOO	US	UP	P	V/V0	US	P	MAT
7.86	5.57	1.09	477	0.804		339	BR
7.86	6.54	1.64	843	0.749		847	-
7.86	6.57	1.66	857	0.748		860	-
7.86	6.65	1.74	911	0.738		917	-
7.86	6.71	1.79	943	0.733		950	-
7.86	6.63	1.86	968	0.720		988	-
7.86	6.89	1.89	1024	0.726		1030	-
7.86	6.95	1.89	1033	0.728		1034	-
7.85	7.42	2.17	1267	0.707		1267	-
7.86	7.42	2.19	1276	0.705		1276	-
7.86	7.66	2.32	1397	0.697		1397	-
7.86	7.58	2.34	1393	0.692		1393	-
7.86	8.00	2.57	1618	0.679		1618	-
7.86	8.22	2.68	1728	0.675		1728	-
7.86	8.20	2.68	1730	0.673		1730	-
7.86	5.33	1.03	430	0.807	5.40		CU
7.86	5.49	1.04	451	0.810	5.44		-
7.86	5.57	1.10	481	0.803	5.52		-
7.86	5.60	1.13	499	0.797	5.57		-
7.86	5.57	1.14	498	0.796	5.57		-
7.86	6.29	1.45	718	0.769	6.05		-
7.86	6.84	1.81	973	0.735	6.57		-
7.86	7.40	2.12	1232	0.714	7.03		-
7.86	7.36	2.13	1231	0.711	7.04		-
7.87	7.67	2.30	1385	0.701	7.29		-
7.87	7.57	2.31	1375	0.695	7.29		-
7.87	7.73	2.33	1418	0.699	7.34		-
7.87	7.62	2.34	1405	0.693	7.34		-
7.86	8.14	2.60	1663	0.681	7.73		-
7.86	8.16	2.64	1693	0.677	7.78		-
7.85	8.68	2.89	1967	0.667	8.17		-

US = 3.768 + 1.655 UP KM/SEC. SIGMA US = 0.101 PERCENT

COMMENTS:

1) SOURCE: MCQUEEN, R. G. AND MARSH, S. P.
J. APPL. PHYS., VOL. 31, P. 1253 (1960)

ALSO PRIVATE COMMUNICATION
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.

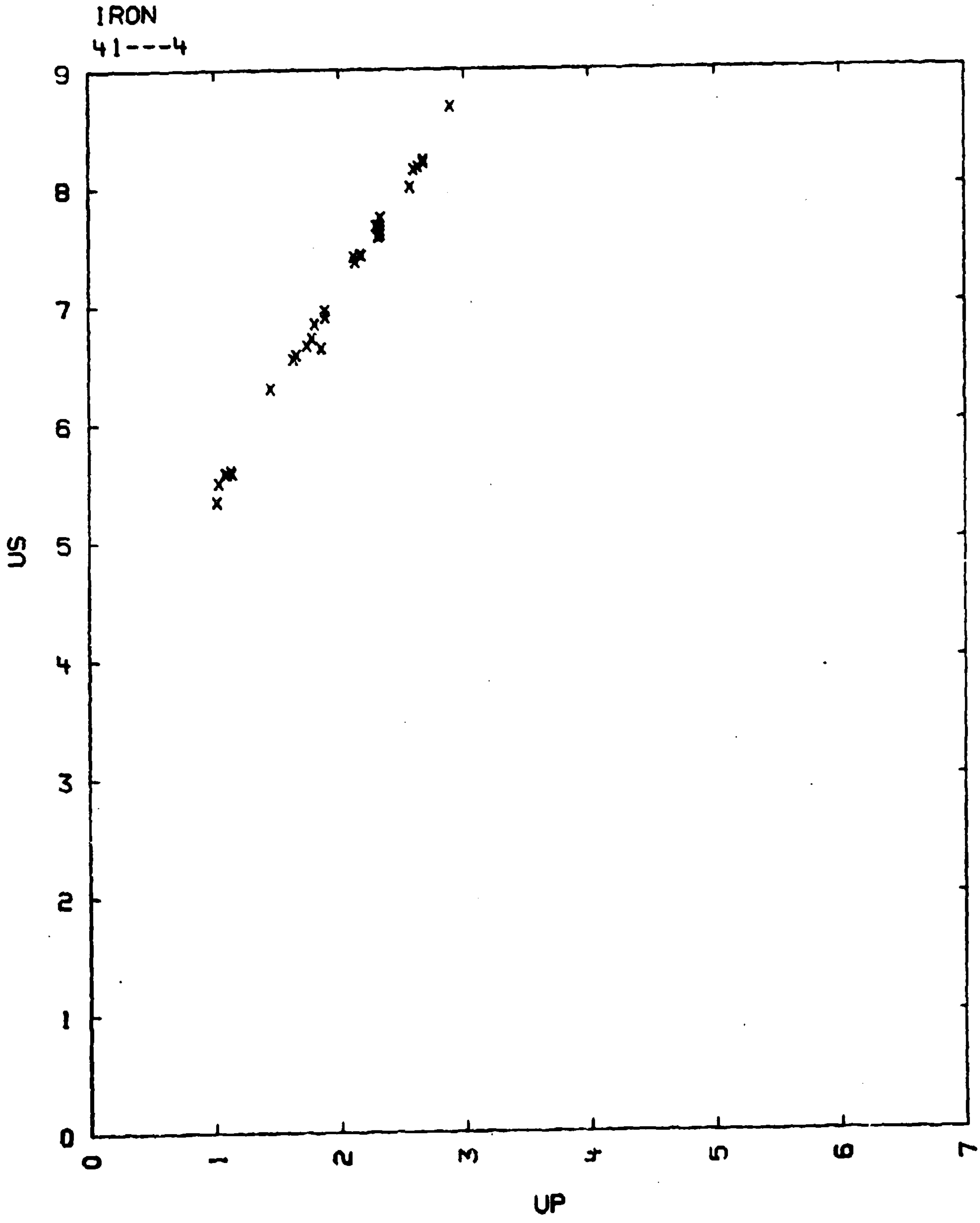
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL AS INDICATED IN THE TABLE.

3) FOR THE BRASS STANDARD DATA SEE MATERIAL 36-33

4) CL AND CS VALUES WERE OBTAINED FROM THE AMERICAN INSTITUTE OF PHYSICS HANDBOOK, 2ND ED., 1957

5) VO1 WAS OBTAINED FROM THE SAME SOURCE

TABLE I



41---5
IRON, ARMCO

FE 99.99 PERCENT

V0 = 0.1274 CC/G CL = 5.97 KM/SEC
V01= 0.1269 CC/G

TABLE I LISTS LONGITUDINAL SOUND VELOCITY AS WELL AS SHOCK AND PARTICLE VELOCITIES OF THE MULTIPLE WAVE SYSTEM IN KM/SEC. D IS THE SAMPLE THICKNESS IN MM AND THE EXPERIMENT OR LINE NUMBER (NO) FOLLOWS THE NUMBERING OF THE SOURCE. FOR THE PRESSURES AND V/V0 SEE TABLE II
* UNCERTAIN POINT, SEE COMMENTS

TABLE I

NO	CL	US1	UP1	US2	UP2	US3	UP3	D
6	5.97	6.04	0.0143	5.09	0.277			133.63
7	-	-		5.04	0.313			56.93
8	-	-		5.05	0.324			38.63
9	-	-		5.09	0.327			24.74
10	-	-		5.12	0.335			25.41
11	-	-		5.13	0.325			25.46
24-25	5.92	5.99	0.0170					24.78
26-28	-	-	-	5.01	0.302			25.34
29-31	5.81	5.74	0.0291					25.49
29-31	-	5.33	0.0332*					-
32-34				4.995	0.339*			25.48
35	5.90	5.91	0.0151					25.30
36	5.89	5.92	0.0254					25.23
1A		6.04	0.0142	5.09	0.2635			133.63
2A				5.04	0.3125			57.2
3A		-	-	5.05	0.324	3.13	0.402	38.63
4A				5.06	0.321		0.420	31.8
5A		-	-	5.05	0.327	3.41	0.465	24.74
6A					0.32		0.50	19.11
7A		-	-	-	0.330	3.61	0.5345	13.25
8A		-	-	-	0.3405	3.71	0.5665	7.21

US3 = 1.76 + 3.46*UP KM/SEC FOR UP FROM 0.4 TO 0.6 KM/SEC
SIGMA US3 = 0.033 KM/SEC

TABLE II LISTS DENSITY IN G/CC AND PRESSURE IN KBARS. THE SIGNIFICANCE OF THE THERMAL HISTORY (THIST) IS GIVEN IN THE COMMENTS. AS IN TABLE I THE LINE NUMBERING FOLLOWS THAT OF THE SOURCE.
* UNCERTAIN POINT, SEE COMMENTS

TABLE II

NO	RHOO	P1	V1/V0	P2	V2/V0	P3	V3/V0	THIST
6	7.851	6.8	0.9979	112.1	0.9460			ANN
7	-	-	-	124.9	0.9382			-
8	-	-	-	129.7	0.9366			-
9	-	-	-	131.8	0.9358			-
10	-	-	-	135.8	0.9350			-
11	-	-	-	132.0	0.9374			-
24-25	7.854	8.0	0.9974					AR
26-28	-	-	-	127.6	0.9362			-
29-31	7.840	13.1	0.9949					CR
29-31	-	14.8	0.9941*					-
32-34	-			134.9	0.9330*			-
35	7.844	7.0	0.9977					CRHT
36	7.842	11.8	0.9959					CRHT
1A	7.851	6.8	0.9977	106	0.9487			
3A	-	-		130	0.9363	147	0.909	
5A	-	-		131	0.9356	165	0.892	
7A	-	-		132	0.9351	188	0.877	
8A	-	-		136	0.9331	200	0.871	

COMMENTS:

1) SOURCE: MINSHALL, F. S.
MET. SOC. CONF., VOL. 9, P. 249 (1961)
ALSO BANCROFT, D., PETERSON, E. L. AND MINSHALL, S.
J. APPL. PHYS., VOL. 27, P. 291 (1956)

2) EXPERIMENTAL TECHNIQUE A. EXCEPT NO. 24-25, 29-31, 35 AND 3E, WHERE TECHNIQUE G WAS USED.
DATA REDUCTION METHOD D WITH 2UP = UFS

3) THE FIRST WAVE (SUBCRIPT 1) IS INTERPRETED AS THE ELASTIC WAVE AND WAS ASSUMED TO BE IDENTICAL TO THE ONE MEASURED IN 1A FOR LINE 1A-8A AND EQUAL TO THE ONE MEASURED IN LINE 6 FOR LINE 6-11, EVEN THOUGH IN LINE 10, THE INITIAL SAMPLE TEMPERATURE WAS -51 DEG. CENTIGRADE AND IN LINE 11, +56.5 DEG. CENTIGRADE.
THE ELASTIC WAVE IN EXPERIMENTS 29-31 SEEMED TO BE SPLIT INTO TWO WAVES, BOTH RUNNING SLOWER THAN THE LONGITUDINAL SOUND VELOCITY. THIS DOUBLE WAVE STRUCTURE WAS USED IN THE ANALYSIS OF LINE 32-34

4) THE THERMAL HISTORY SYMBOLS ARE DEFINED AS FOLLOWS:
ANN = ANNEALED
AR = AS RECEIVED
CR = COLD ROLLED
HT = HEAT TREATED: EXP. 35 HELD AT 950 DEG. C. FOR 2 HRS
EXP 36 HELD AL 600 DEG. C. FOR 2 HRS

5) THE ATTENUATION OF THE 3RD SHOCK WAS TAKEN INTO ACCOUNT IN EXP. 1A-8A

6) HERE A REFERS TO THE RESULTS OF THE EARLIER REFERENCE. P AND V/V0 WERE NOT CALCULATED FOR EXP. 6A BECAUSE OF THE LOWER ACCURACY OF THIS SIMPLER EXPERIMENT, AND FOR 2A AND 4A BECAUSE THESE WERE DESIGNED PRIMARILY TO MEASURE US2, FOR USE IN LINES 3 5 7 AND 8.

7) ALL VALUES OF P2 EXCEPT THOSE OF THE 133 MM SAMPLES, NO 6 AND 1A WERE FOLLOWED BY A THIRD WAVE AND THEREFORE TRANSITION WAVES. A PLOT OF

P2 VS. 1/D SUGGESTS THAT THE TRANSITION COULD BE AS LOW AS 123
PLUS OR MINUS 3 KBARS

8) V0I WAS OBTAINED FROM WYCKOFF, CRYSTAL STRUCTURES, VOL. 1 (JOHN
WILEY AND SONS, NEW YORK, 1963)

TABLE I

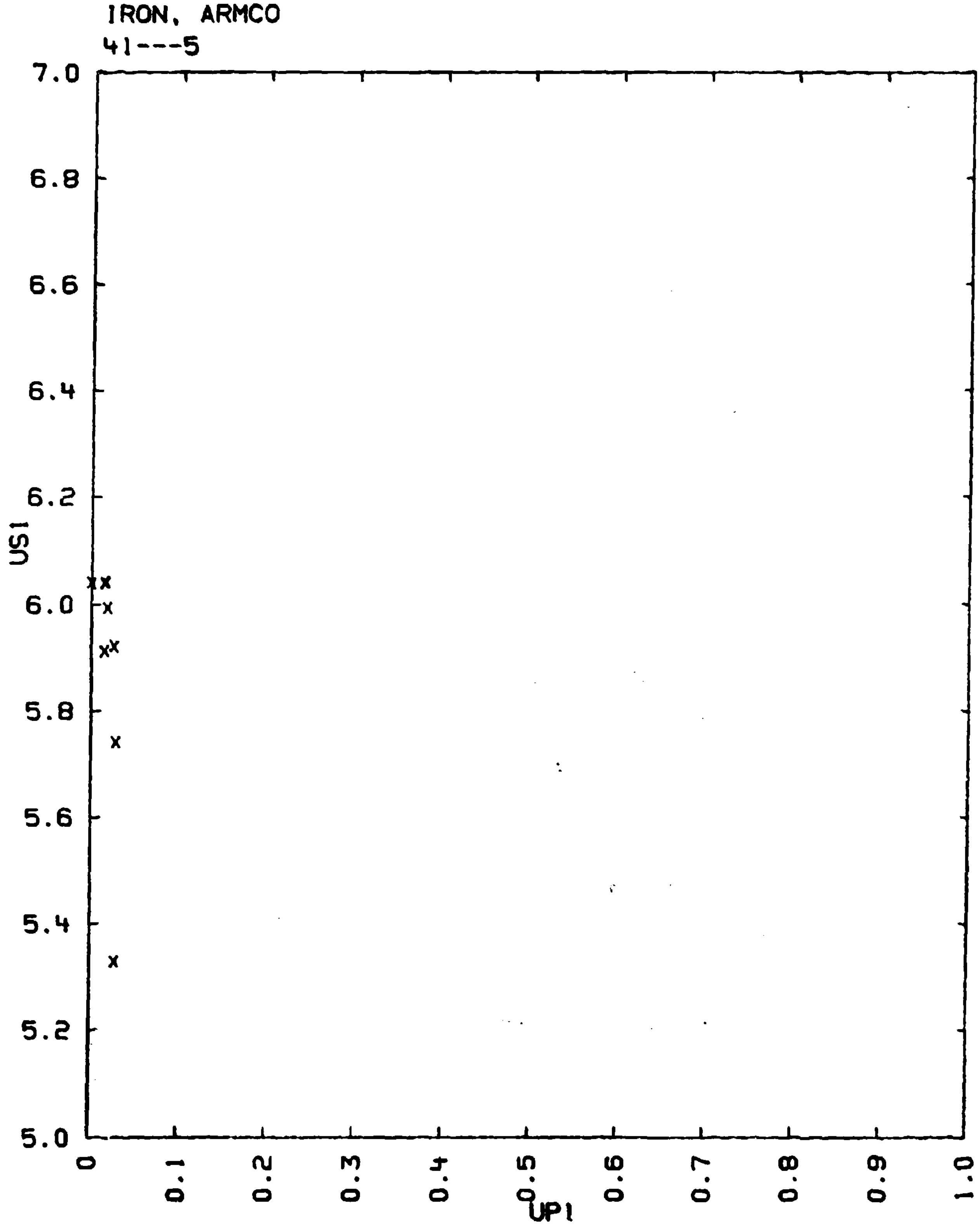

IRON, ARMCO
41---5
7.0
6.8
6.6
6.4
6.2
6.0
5.8
5.6
5.4
5.2
5.0
US1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP1

TABLE I

IRON, ARMCO
41---5

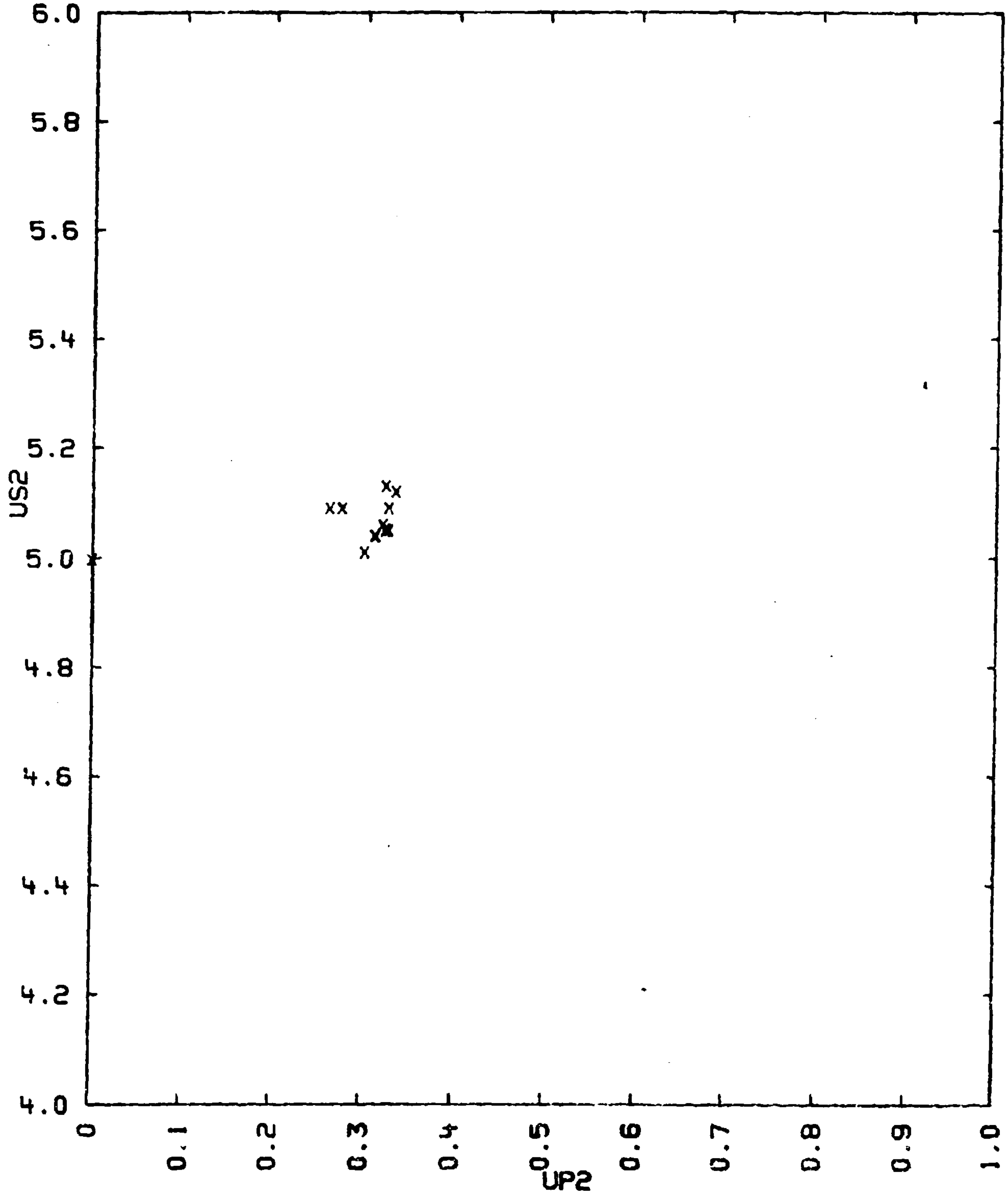
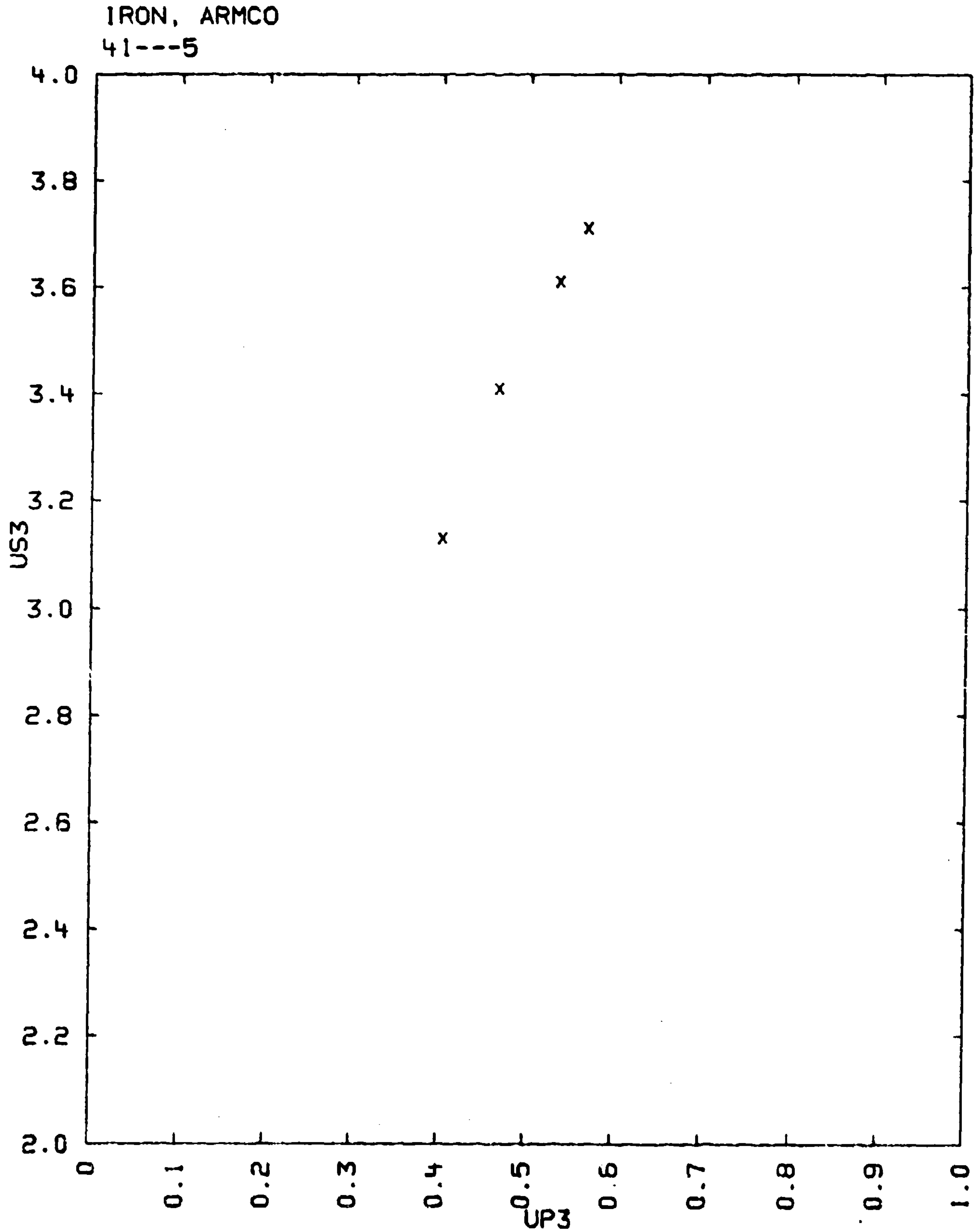


TABLE I



IRON, ARMCO
41---5
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
US3
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP3

41---6
IRON

FE

V0 = 0.1274 CC/G.
V01 = 0.1272 CC/G. CB = 4.65 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

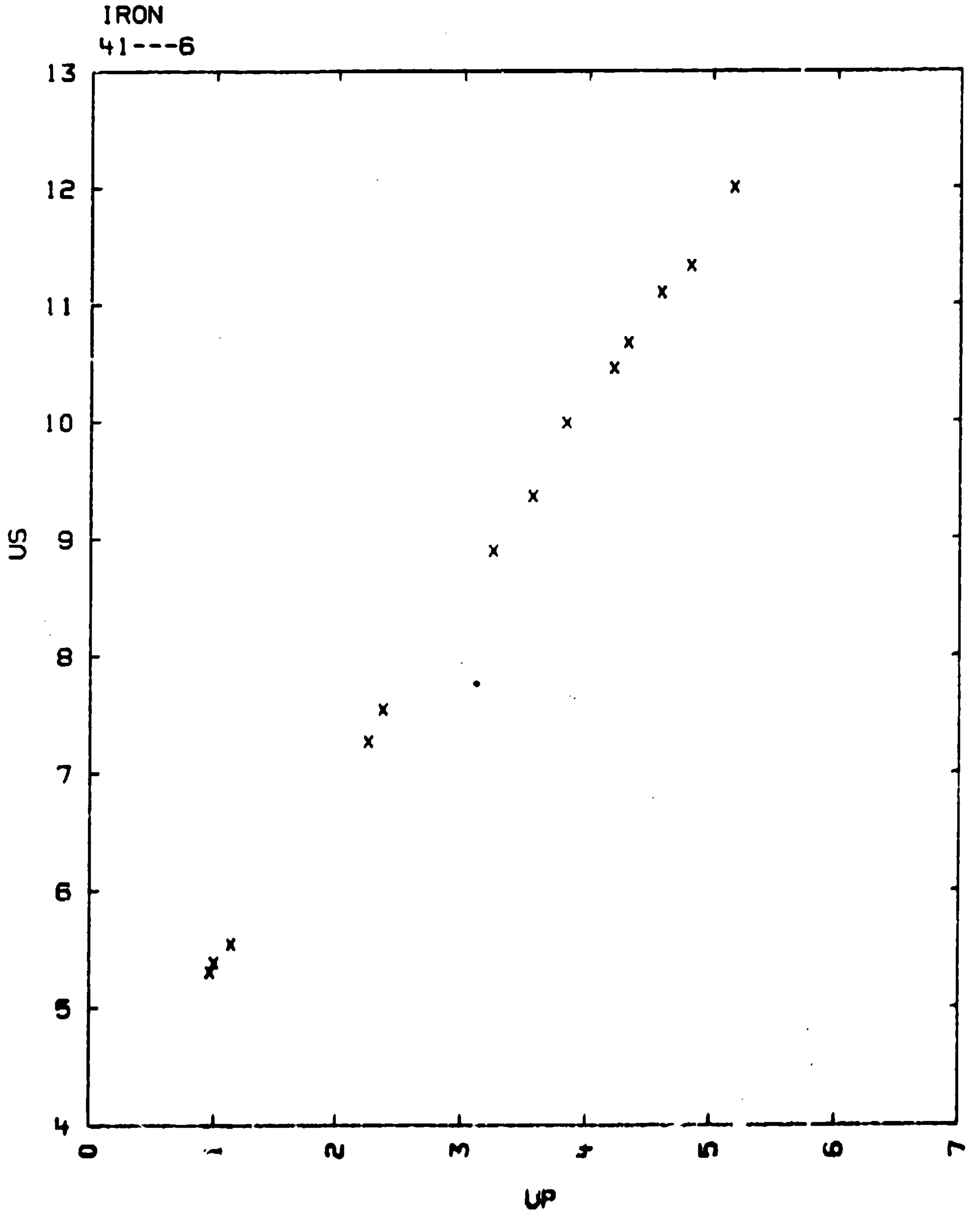
RHOO	US	UP	P	V/VO
7.85	5.30	0.97	400	0.8170
-	5.38	1.00	422	0.8143
-	5.54	1.14	500	0.7943
-	7.27	2.26	1290	0.6892
-	7.54	2.38	1410	0.6645
-	8.89	3.25	2270	0.6345
-	9.36	3.56	2620	0.6196
-	9.98	3.83	3000	0.6161
-	10.45	4.20	3440	0.5981
-	10.67	4.32	3620	0.5952
-	11.10	4.59	4000	0.5865
-	11.32	4.83	4290	0.5734
-	12.00	5.17	4870	0.5691

US = 3.74 + 1.594 UP, SIG.US = 0.066 KM/SEC.
FOR UP = 0.97 TO 5.17 KM/SEC.

COMMENTS:

1) SOURCE: AL'TSHULER, L. V., KRUPNIKOV, K. K., LEDENEV, B. N., ZHUCHIKHIN, V. I. AND BRAZHNIK M. I. SOVIET PHYS.-JETP, VOL. 34, P. 606 (1958)
2) EXPERIMENTAL TECHNIQUE A. DATA REDUCTION TECHNIQUE B, FOR US RANGING TO 7.54 KM/SEC. AND TECHNIQUE A, FOR US = 5.54 AND ABOVE 8.0 KM/SEC.
3) V01 WAS OBTAINED FROM THE AMERICAN INSTITUTE OF PHYSICS HANDBOOK (MCGRAW-HILL BOOK CO. N.Y., 1963) 2ND ED.
4) EACH VALUE OF US AND UP IS THE AVERAGE VALUE TAKEN FROM THREE OR FOUR EXPERIMENTS. THE RELATIVE SIGMA IS 1.0 PERCENT.
5) THE PRESSURES WERE MEASURED WITH 1.5 - 2.0 PERCENT ACCURACY.
6) CB IS CALCULATED USING THE VOLUME COMPRESSION COEFFICIENT TAKEN FROM P. W. BRIDGMAN, THE PHYSICS OF HIGH PRESSURE, (G. BELL AND SONS LTD. LONDON 1958)

TABLE I



41---7
IRON

FE

VO = 0.1274 CL = 5.95 KM/SEC. CO = 4.627 KM/SEC.
VOI = 0.1271 CC/G CS = 3.240 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC ST DESIGNATES THE STANDARD METERIAL USED AS STRIKER. U(ST) IS THE VELOCITY OF STRIKER BEFORE IMPACT.

TABLE

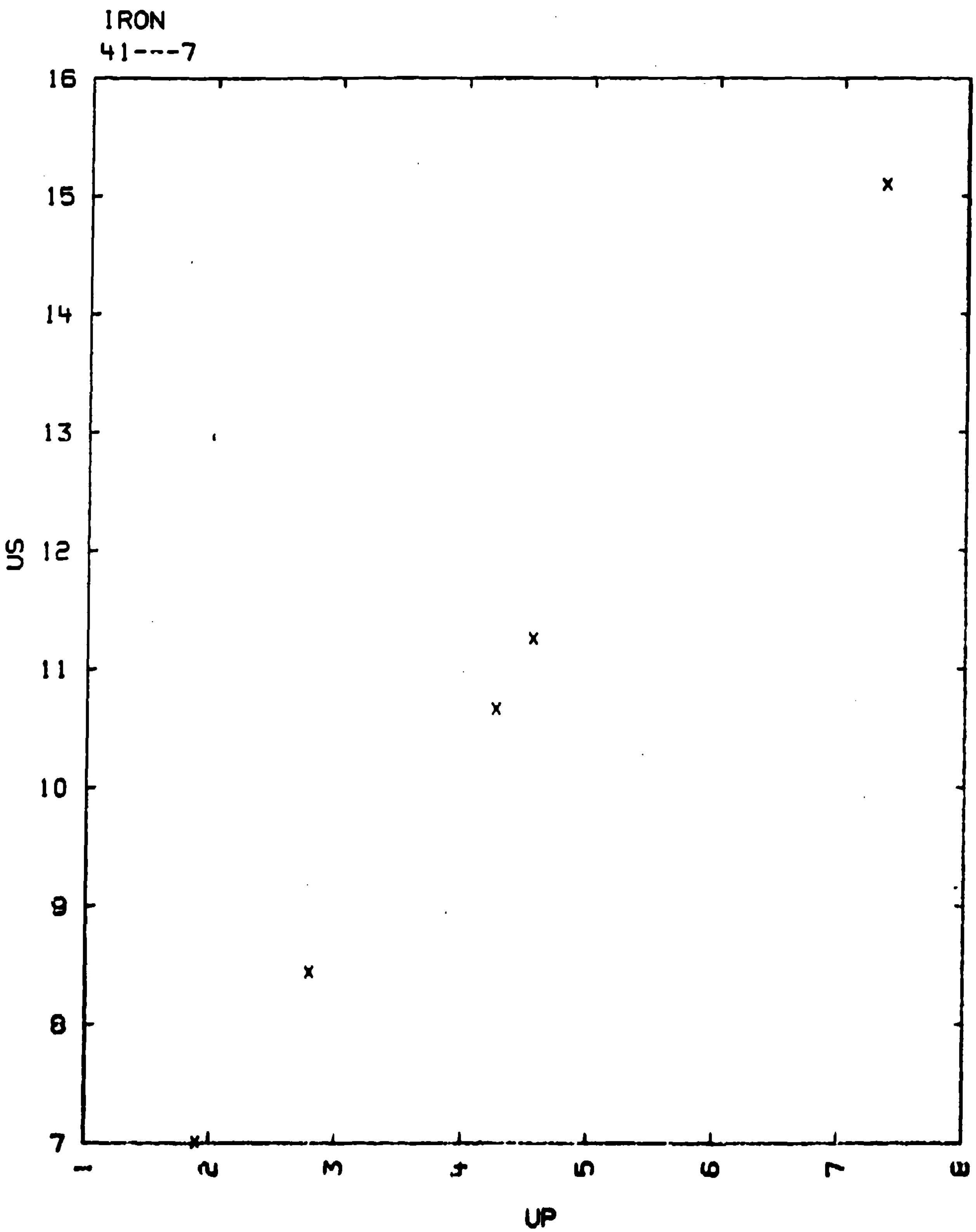
RHOO	US	UP	P	V/VO	ST	U(ST)
7.85	7.01	1.90	1045	0.7280	AL	5.60
-	8.44	2.80	1855	0.6684	FE	5.60
-	10.67	4.26	3568	0.6010	FE	8.64
-	11.26	4.55	4022	0.5959	FE	9.10
-	15.10	7.34	8700	0.5136	FF	14.68

US = 4.29 + 1.49 UP KM/SEC. FOR UP BETWEEN 1.90 TO 7.34 KM/SEC.
SIGMA US =0.15 KM/SEC.

COMMENTS:

1) SOURCE: AL'TSHULER, L.V., KORMER, S.B., BAKANOVA, A.A. AND TRUNIN, R.F.
SOVIET PHYS.-JETP, VOL. 11, P. 573 (1960)
AL'TSHULER ET AL
SOVIET PHYS.-JETP, VOL. 15, P. 65 (1962).
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE A
3) THE PRESSURES WERE PRODUCED BY AN EXPLOSIVELY ACCELERATED ALUMINUM OR STEEL PLATE AS INDICATED IN COLUMN 6.
4) FOR PRESSURES TO 4022 KILOBARS THE RELATIVE SIGMA FOR US AND UP DID NOT EXCEED 1.0 PERCENT. EACH POINT IS THE AVERAGE OF 4 TO 6 EXPERIMENTS.
5) THE U UNCERTAINTY OF THE VALUES IN THE LAST TABLE ENTRY ARE:
1 PECENT IN US OBTAINED FROM 6 TO 8 EXPERIMENTS AND 1.5 PERCENT IN U(ST) OBTAINED FROM 12 EXPERIMENTS.
6) CL CS AND VOI WERE OBTAINED FROM THE AMERICAN INSTITUTE OF PHYSICS HANDBOOK (MCGRAW-HILL BOOK CO. N.Y., 1963) 2ND ED.

TABLE I



41---8
IRON

FE

V0 = 0.1274 CC/G
V01 = 0.1272 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

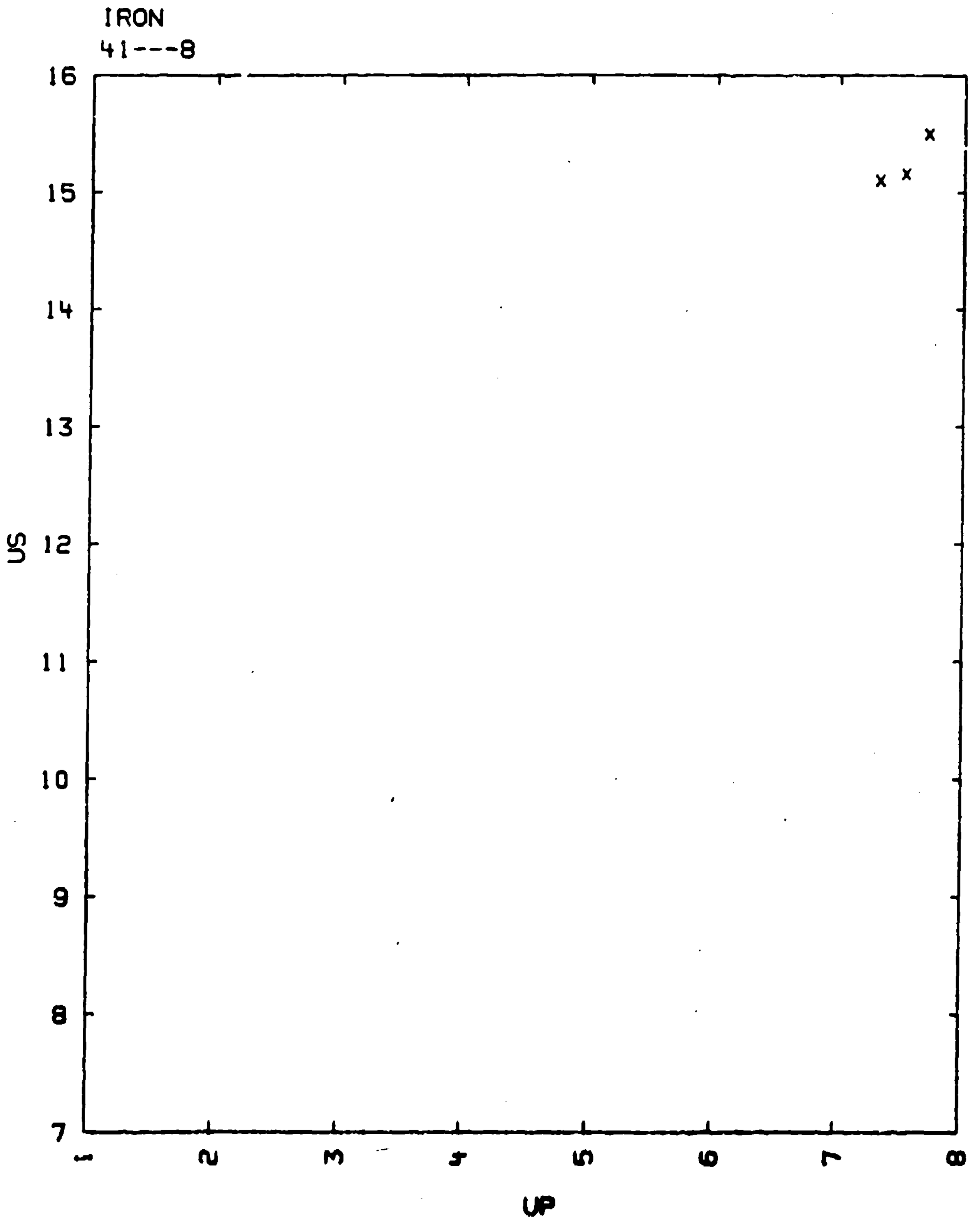
RHO0	US	UP	P	V/V0
7.85	15.50	7.71	9380	0.5025
-	15.15	7.52	8940	0.5038
-	15.10	7.32	8700	0.5139

US = 7.59 + 1.02 UP KM/SEC.   FOR UP BETWEEN 7.71 TO7.32 KM/SEC.
SIGMA US = 0.12 KM/SEC.

COMMENTS:

1) SOURCE: KRUPNIKOV, K.K., BAKANOVA, A.A., BRAZHNIK, M.I
AND TRUNIN, R.F.
SOVIET PHYS.-JETP, VOL. 8, P. 205 (1963)
2) EXPERIMENTAL TECHNIQUE A (UNCERTAIN, NOT DISCUSSED
DATA REDUCTION TECHNIQUE A FOR LAST ENTRY, THE REST IS NOT DISCUSSED
3) V01 WAS OBTAINED FROM THE AMERICAN INSTITUTE OF PHYSICS HANDBOOK
(MCGRAW-HILL BOOK CO. 1963) 2ND ED.

TABLE I



41---9
IRON

FE

VO = 0.128 CC/G.
VOI = 0.1272 CC/G.

THE TABLES BELOW GIVE THE VELOCITIES OF RELAXATION WAVES, C, AT VARIOUS PRESSURES. THE HUGONIOT STATE THE RELAXATION WAVE TRAVELS THROUGH IS GIVEN BY US, UP, P, OR V/VO. DENSITY IS GIVEN IN G/CC, VELOCITY IN KM/SEC AND PRESSURE IN KILOBARS. IN TABLE II, ST DESIGNATES THE MATERIAL OF THE STRIKER PLATE, U(ST) IS THE VELOCITY BEFORE IMPACT AND US(ST) IS THE SHOCK VELOCITY IN THE PLATE AFTER IMPACT.

TABLE I

SOUND VELOCITIES
PERPENDICULAR TO SHOCK DIRECTION

RHOO	US	UP	P	V/VO	C
7.81	5.34	0.98	409	0.816	7.15

US =

TABLE II

SOUND VELOCITY
PARALLEL TO SHOCK DIRECTION

---HUGONIOT STATE--------						--DRIVER SYSTEM--		
RHOO	US	UP	P	V/VO	C	ST	U(ST)	US(ST)
7.81	7.01	1.91	1045	0.7278		AL	5.60	10.31
-	5.76	1.20	542	0.7918	6.70	AL	5.60	10.31
-	5.34	0.99	415	0.8143	6.12	AL	5.60	10.31
-	8.57	2.86	1914	0.6658		FE	5.71	8.54
-	8.21	2.62	1680	0.6793	8.49	FE	5.71	8.54
-	7.39	2.12	1223	0.7117	7.85	FE	5.71	8.54
-	10.7	4.15	3478	0.6061	9.98	FE		
-	9.86	3.70	2849	0.6250	9.53	FE		

US =

COMMENTS:

1) SOURCE: AL'TSHULER, L. V., KORMER, S. B., BRAZHNIK, M. I., VLADIMIROV, L. A. AND FUNTIKOV, A. I. SOVIET PHYS.-JETP, VOL.11, P. 766 (1960)
2) EXPERIMENTAL TECHNIQUE A WAS USED IN TABLE II FOR THE FIRST THREE

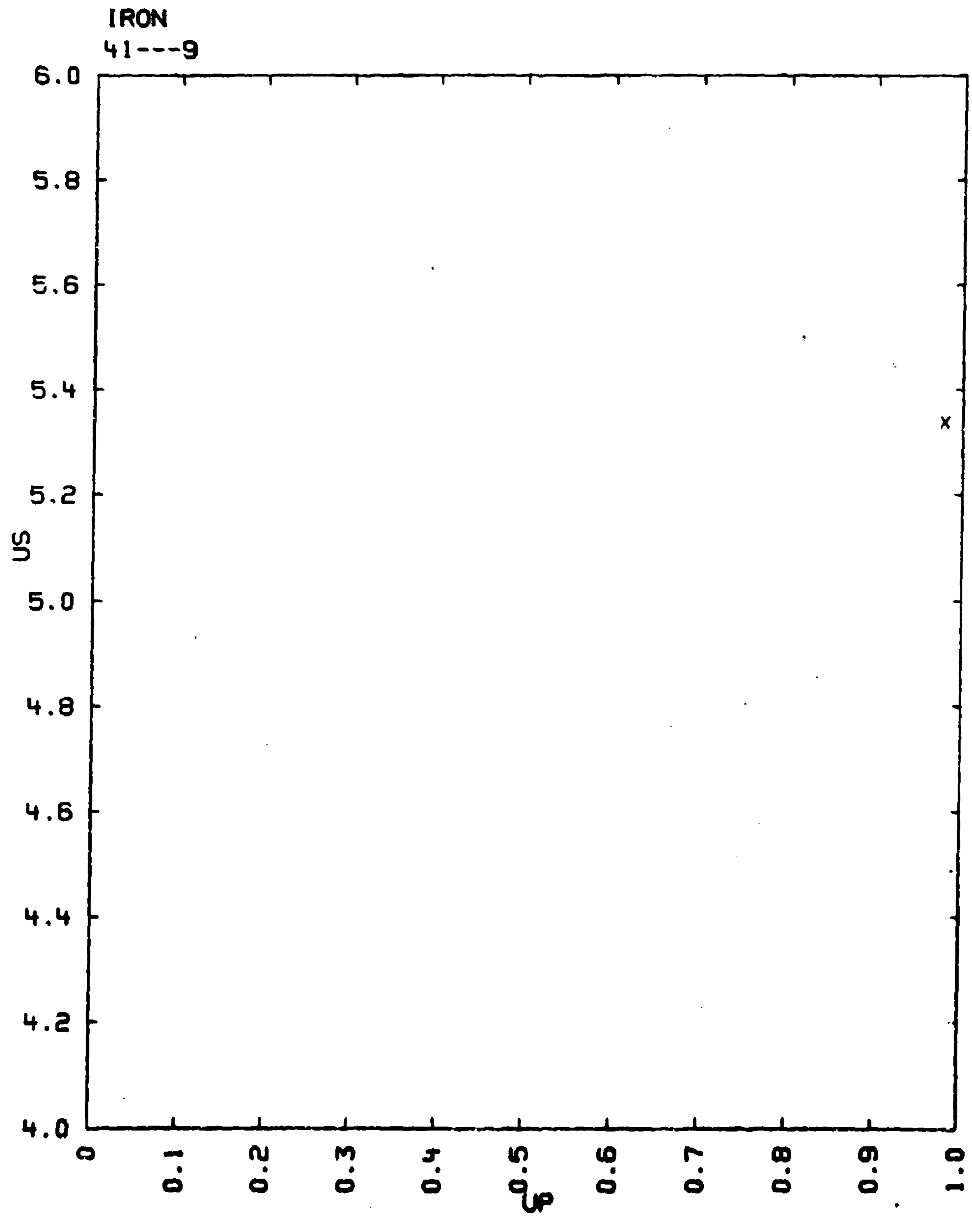
ENTRIES. FOR ALL OTHER ENTRIES EXPERIMENTAL TECHNIQUE B WAS USED. THE HUGONIOT STATE WAS DETERMINED FROM ONE MEASURED PARAMETER AND THE KNOWN EQUATION OF ST..TE. AL'TSHULER ET AL. SOVIET PHYS-JETP, VOL. 11, P. 573 (1960).

3) THE SOUND VELOCITY IN TABLE I WAS OBTAINED FROM THE SHAPE OF THE FREE SURFACE AFTER IT HAD MOVED SOME DISTANCE. IN TABLE II THE SOUND VELOCITY WAS DETERMINED FROM THE ATTENUATION IN THE MEASURED SHOCK OR FREE SURFACE VELOCITY PRODUCED BY THE RAREFACTION WAVE ORIGINATING AT THE REAR SURFACE OF THE STRIKER PLATE.

4) V0I WAS OBTAINED FROM THE HANDBOOK OF CHEMISTRY AND PHYSICS (THE CHEMICAL RUBBER PUBLISHING CO. CLEVELAND, OHIO, 1962-1963) 44TH ED.

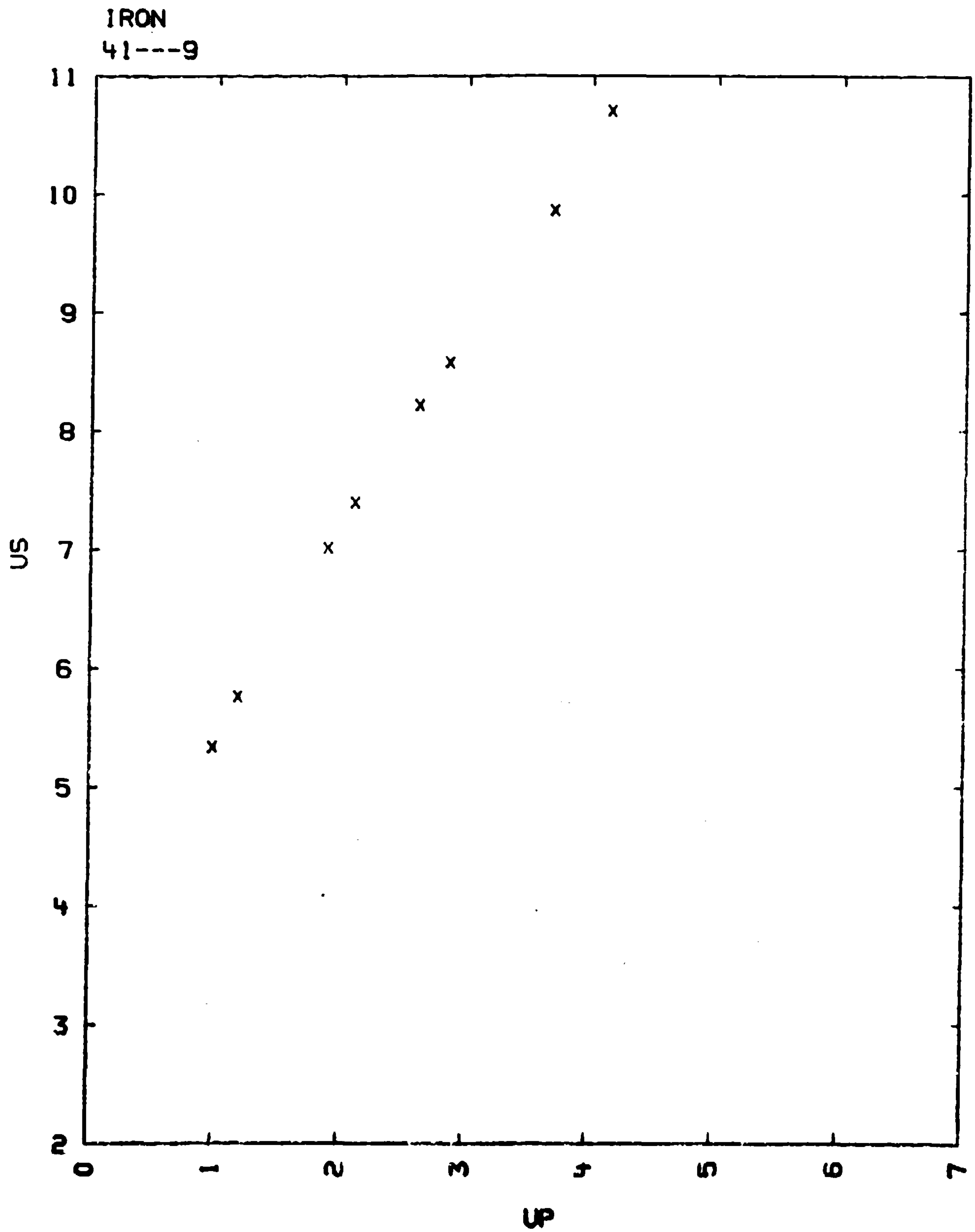
5) THE MEASURED SOUND VELOCITY IS HIGHER THAN THE CALCULATED SOUND VELOCITY FOR A PURELY NONELASTIC SAMPLE.

TABLE I



IRON
41---9
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
US
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP
x

TABLE II



41---10
STEEL, 1020 ALLOY (IRON)

			WEIGHT PERCENT
C	0.18-0.23		
MN	0.30-0.60		- -
P	0.040	MAXIMUM	- -
S	0.050	"	- -
FE	REMAINDER		- -

V0 = 0.1276 CC/G   CL = 5.93 KM/SEC

TABLE I LISTS LONGITUDINAL SOUND VELOCITY, SHOCK VELOCITY AND PARTICLE VELOCITY IN KM/SEC. THIS DOUBLE WAVE SYSTEM CORRESPONDS TO THE PRESSURES AND COMPRESSIONS IN TABLE II. THE LINE NUMBERS ARE THOSE OF THE SOURCE. D IS THE SAMPLE THICKNESS IN MM.

TABLE I

NO	CL	US1	UP1	US2	UP2	D
1	5.94	6.02	0.0240	5.08	0.1900	127.01
2	-	5.93	0.0256	5.09	0.2700	127.01
3	-	6.03	0.0239	5.11	0.1700	127.00
4	5.91	6.08	0.0264	5.12	0.245	127.01
12	5.93	5.95	0.0330	5.09	0.318	51.01
13	-	5.95	0.0270	5.09	0.317	50.90
14	5.91	5.98	0.0264	5.08	0.2228	126.98
15		-	-	5.05	0.342	26.86

US =

TABLE II LISTS THE DENSITY IN G/CC AND PRESSURE IN KBARS. THE SIGNIFICANCE OF THE THERMAL HISTORY (THIST) IS GIVEN IN THE COMMENTS. AS IN TABLE I THE LINE NUMBERING FOLLOWS THAT OF THE SOURCE.

TABLE II

NO	RHO0	P1	V1/V0	P2	V2/V0	THIST
1	7.837	11.3	0.9961	77.4	0.9632	AR
2	-	11.9	0.9953	109.5	0.9475	-
3	-	11.3	0.9961	69.8	0.9670	-
4	7.836	12.6	0.9960	100.1	0.9528	-
12	7.837	15.4	0.9945	129.2	0.9381	-
13	-	12.6	0.9953	128.3	0.9381	ANN
14	7.839	12.4	0.9955	90.5	0.9571	-
15	-	-	-	137.1	0.9477	-

COMMENTS

1) SOURCE: MINSHALL, F.S.
MET. SOC. CONF., VOL. 9, P. 249 (1961)
J. APPL. PHYS., VOL 26, P. 463 (1955)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION METHOD D, WITH 2UP = UFS
3) THE THIST SYMBOLS ARE DEFINED AS FOLLOWS
AR = AS RECEIVED
ANN = ANNEALED
4) IN TABLE II ONLY VALUES OF P2 ABOVE 1[illegible]8 KBARS ARE TRANSITION POINTS

TABLE I

STEEL, 1020 ALLOY (IRON)
41---10

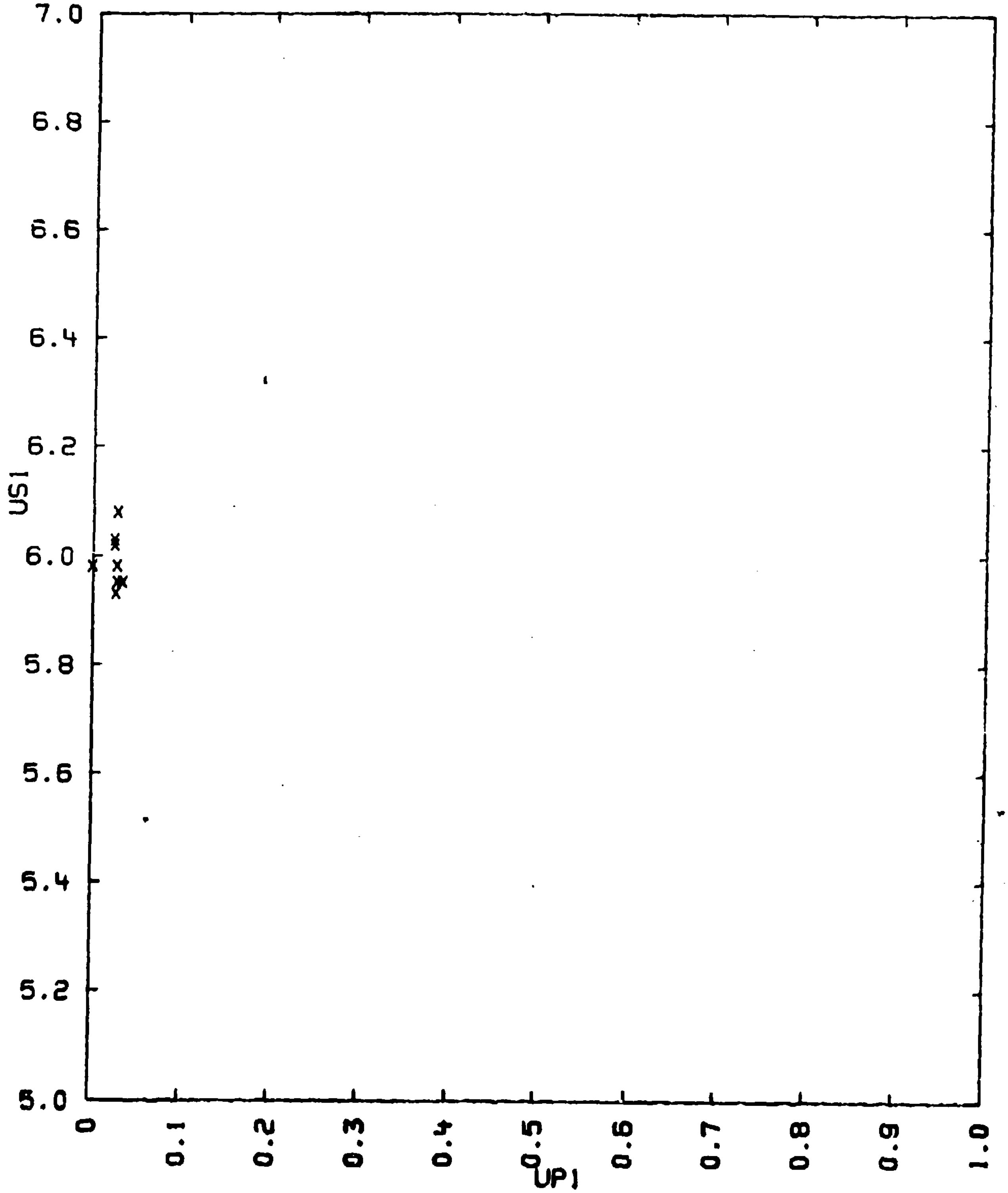
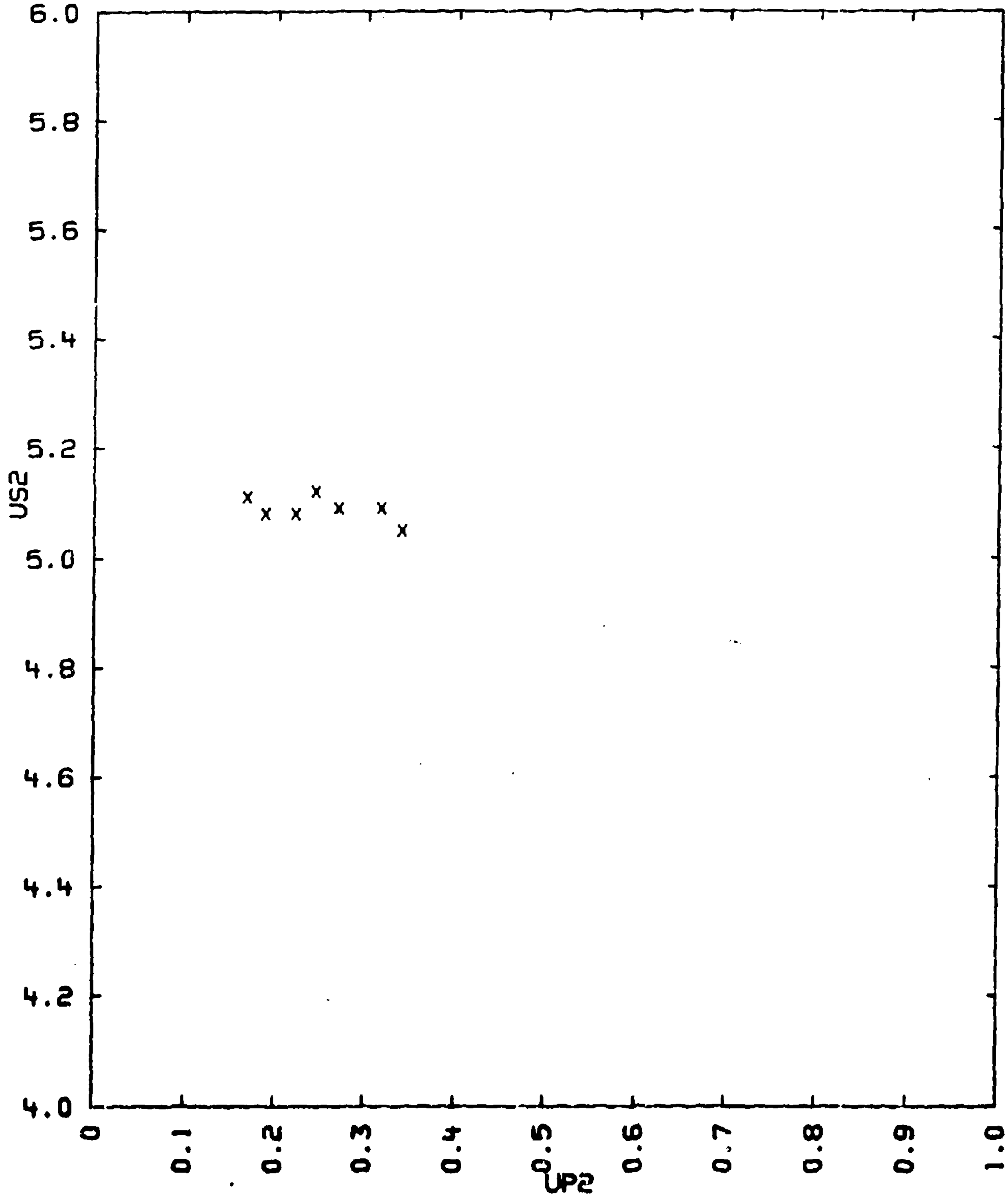


TABLE I

STEEL, 1020 ALLOY (IRON)
41---10



41---11
STEEL, 1040 ALLOY (IRON)

C	0.37-0.44	WEIGHT	PERCENT
MN	0.60-0.90	-	-
P	0.040 MAX.	-	-
S	0.050 -	-	-
FE	REMAINDER	-	-

V0 = 0.1277 CC/G   CL = 5.92 KM/SEC

TABLE I LISTS LONGITUDINAL SOUND VELOCITY, SHOCK AND PARTICLE VELOCITY IN KM/SEC. THIS DOUBLE WAVE SYSTEM CORRESPONDS TO THE PRESSURES AND COMPRESSIONS IN TABLE II. THE LINE NUMBERING FOLLOWS THE SOURCE. D IS THE SAMPLE THICKNESS IN MM.

TABLE I

NO	CL	US1	UP1	US2	UP2	D	
5	5.92	5.97	0.0124			127.02	
-	-	5.54	0.0248	5.18	0.2500	-	SEE COMMENTS
16	5.93	5.99	0.0294	5.10	0.2240	126.94	
17		-	-	5.06	0.3364	26.84	
20	5.89	5.96	0.0268			127.26	
-	-	5.51	0.0326	5.11	0.2724	-	

US =

TABLE II

NO	RHO0	P1	V1/V0	P2	V2/V0	THIST
5	7.818	5.8	0.9976			AR
-	-	11.2	0.9960	102.4	0.9522	-
16	7.833	13.8	0.9984	91.5	0.9572	ANN
17	-	-	-	135.9	0.9345	-
20	7.834	12.5	0.9957			AR
-	-	15.0	0.9941	111.0	0.9471	-

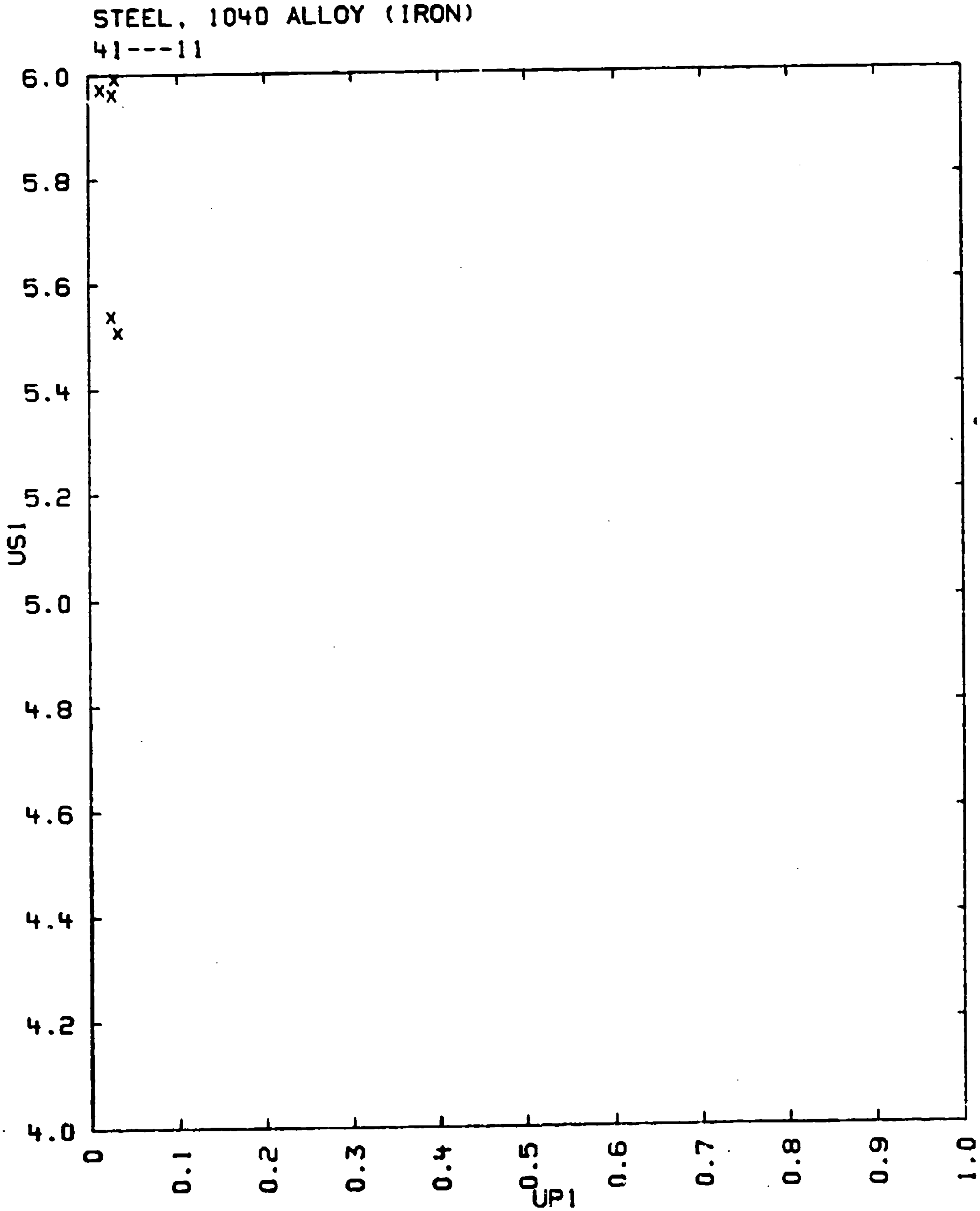
COMMENTS

1) SOURCE: MINSHALL, F.S.
MET. SOC. CONF., VOL. 9, P. 249 (1961)
J. APPL. PHYS., VOL 26, P. 463 (1955)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION METHOD D, WITH 2UP = UFS.
3) THE THIST SYMBOLS ARE DEFINED AS
AR = AS RECEIVED
ANN = ANNEALED

4) IN THE ABOVE TABLE ALL VALUES OF P2 ARE BELOW THE TRANSITION EXCEPT THE ONE FOR EXPERIMENT 17 WHICH INDICATES A RELATIVELY HIGH TRANSITION POINT

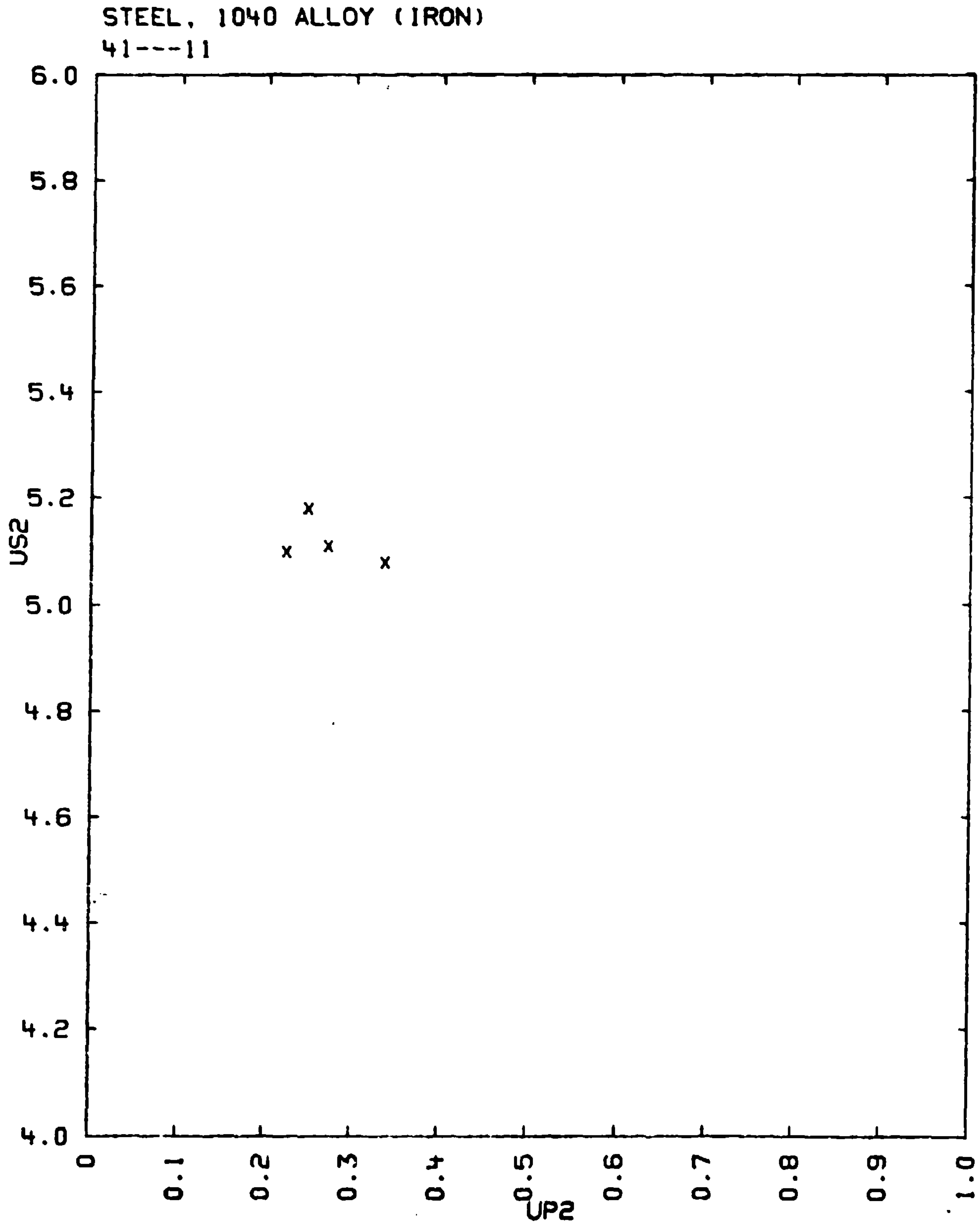
5) THE FIRST WAVE IN EXPERIMENT 5 AND 20 APPEARED TO BE SPLIT INTO TWO PRESSURE STEPS. P2 WAS THEREFORE CALCULATED AS THE THIRD WAVE IN A THREE WAVE SYSTEM. NOTE THAT THIS DID NOT OCCUR IN THE ANNEALED SAMPLES

TABLE I



STEEL, 1040 ALLOY (IRON)
41---11
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
US1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP1

TABLE I



STEEL, 1040 ALLOY (IRON)
41---11
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
US2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP2

41---12
STEEL, 1055 ALLOY (IRON)

C	0.50-0.60	WEIGHT	PERCENT
MN	0.60-0.90	-	-
P	0.040 MAX.	-	-
S	0.050 -	-	-
FE	REMAINDER		

V0 = 0.1278

TABLE I LISTS LONGITUDINAL SOUND VELOCITY, SHOCK AND PARTICLE VELOCITY IN KM/SEC. THIS DOUBLE WAVE SYSTEM CORRESPONDS TO THE PRESSURES AND COMPRESSIONS IN TABLE II. THE LINE NUMBERING FOLLOWS THE SOURCE. D IS THE SAMPLE THICKNESS IN MM.

TABLE I

NO	CL	US1	UP1	US2	UP2	D
18		5.98	0.0310	5.13	0.2305	127.08
19		-	-	5.11	0.3465	26.82
21	5.90	5.99	0.0284	5.13	0.2249	127.24
22	5.93	6.01	0.0302			127.04
23	5.90	6.00	0.0319			124.64

US =

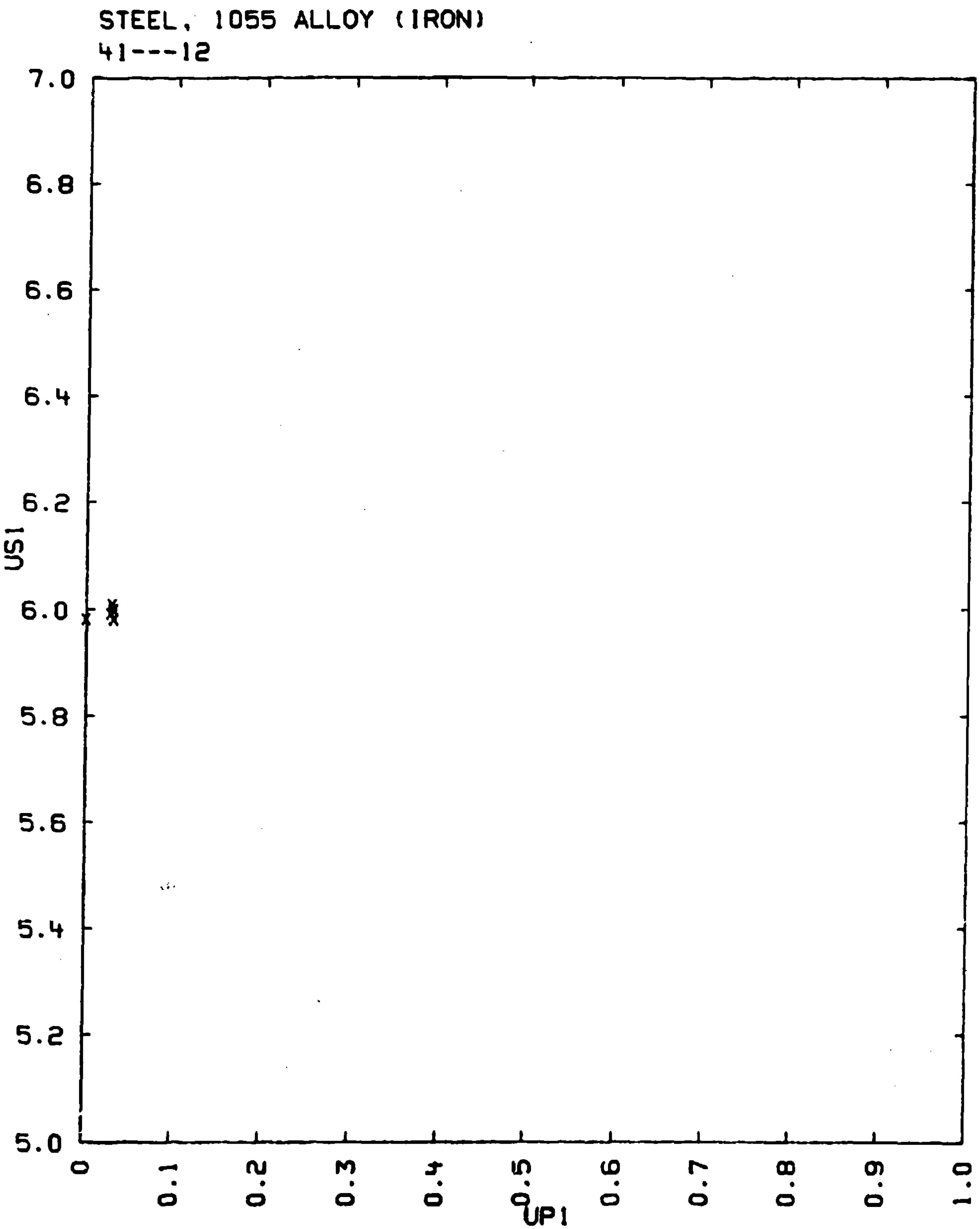
TABLE II

NO	RHO0	P1	V1/V0	P2	V2/V0	THIST
18	7.824	14.5	0.9952	94.5	0.9561	ANN
19	-	-	-	140.5	0.9326	ANN
21	7.825	13.3	0.9953	92.1	0.9570	AR
22	-	14.2	-			ANN
23	-	15.0	0.9946			AR

COMMENTS

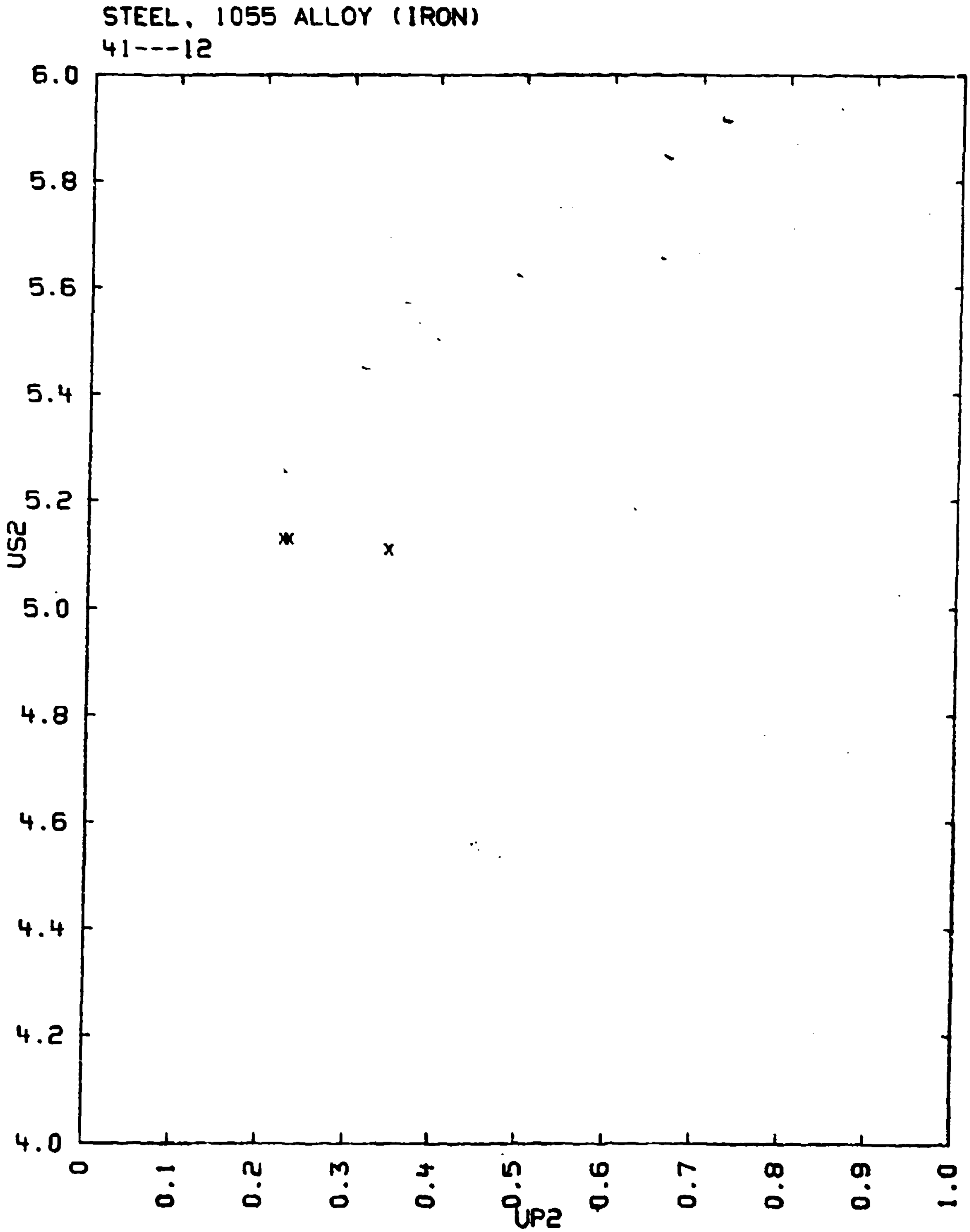
1) SOURCE: MINSHALL, F.S.
MET. SOC. CONF., VOL. 9, P. 249 (1961)
2) EXPERIMENTAL TECHNIQUE A FOR LINE 18, 19 AND 21
G FOR LINE 22 AND 23
DATA REDUCTION METHOD D WITH 2UP = UFS
3) THE THIST SYMBOLS ARE DEFINED AS FOLLOWS
AR = AS RECEIVED
ANN = ANNEALED
4) ONLY THE 140.5 KBAR POINT QUALIFIES AS A TRANSITION POINT

TABLE I



STEEL, 1055 ALLOY (IRON)
41---12
7.0
6.8
6.6
6.4
6.2
6.0
5.8
5.6
5.4
5.2
5.0
US1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP1

TABLE I


STEEL, 1055 ALLOY (IRON)
41---12
US2
UP2
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

41---13
IRON, ARMCO

FE 99.99 PERCENT

TO = VARIABLE
VOI= 0.1270 CC/G AT 25 DEG. C

THE TABLE LISTS THE TEMPERATURES IN DEG. K. AND THE PRESSURES IN KBARS OF TWO IRON PHASE LINES.

PHASE TRANSFORMATION POINTS

TABLE

TO	P
78	150
201	140
248	134
298	128
298	131
360	121
421	124
481	124
540	124
543	121
600	113
660	113
723	115
773	111
783	115
793	105
813	93
833	87
853	87
875	59
975	48
1023	39
1073	32
1158	19

COMMENTS:

1) SOURCE: JOHNSON, P. C., STEIN, B. A. AND DAVIS, R. S.
J. APPL. PHYS., VOL. 33, P. 557 (1962)
2) EXPERIMENTAL TECHNIQUE: MICROSCOPIC EXAMINATION OF RECOVERED- SHOCKED SAMPLES AND DETERMINATION OF THE BOUNDARY OF THE TRANSFORMED PHASE. THE PRESSURE ATTENUATION CURVE WAS ALSO DETERMINED IN THIS WORK TEMPERATURES LISTED ARE THOSE MEASURED BEFORE SHOCK COMPRESSION.
DATA REDUCTION METHOD: COMPARISON OF LOCATION OF THE BOUNDARY BETWEEN

TRANSFORMED AND UNTRANSFORMED MATERIAL WITH
THE PRESSURE ATTENUATION CURVE YIELDED THE
ABOVE P-T LINE AFTER NORMALIZING TO YIELD THE
132 KBAR AT 300 DEG K POINT OF MINSHALL.

3) A SHARP BREAK IN THE PHASE LINE AT ABOUT 770 DEG. K. CORRELATES WELL WITH A DRASTIC CHANGE IN THE MICROSTRUCTURE OF THE TRANSFORMED REGION

4) UNCERTAINTY IN THE PRESSURE DETERMINATION APPEARS TO BE THE DETERMINING FACTOR. MAXIMUM DEVIATION 7 KBAR
NOMINAL - 2-3 KBAR

41---14
IRON (MILD STEEL)

C = FROM 0.40 TO 0.10 PERCENT
S = LESS THAN 0.06 PERCENT
P = LESS THAN 0.06 PERCENT
FE = REMAINDER

VO = 0.1278 CC/G.
VOI = 0.1270 CC/G.

IN TABLE I BELOW, DENSITY IS GIVEN G/CC. AND VELOCITIES IN KM/SEC., ID IS IDENTIFICATION BETWEEN TABLES. 1, 2, AND 3 DESIGNATE FIRST, SECOND, AND THIRD SHOCKS.
IN TABLE II, PRESSURE IS GIVEN IN KILOBARS.

TABLE I

ID	RHOO	US1	UP1	US2	UP2	US3	UP3
1	7.84	5.85	0.027	5.13	0.285		
2	-	-	-	-	0.29		
3	-	-	-	-	0.295		
4	-	-	-	-	0.30		
5	-	-	-	-	0.31		
6	-	-	-	-	0.315		
7	-	-	-	-	0.32		
8	-	-	-	-	0.325		
9	-	-	-	-	0.32 *		
10						3.25	0.34
11	-	-	-	-	-	3.43	0.345
12	-	-	-	-	-	3.24	0.355
13	-	-	-	-	-	3.30	0.36
14	-	-	-	-	-	3.60	0.365
15	-	-	-	-	-	3.36	0.37
16	-	-	-	-	-	3.60	0.38
17	-	-	-	-	-	3.47	0.38
18	-	-	-	-	-	3.57	0.40
19	-	-	-	-	-	3.77	0.42
20	-	-	-	-	-	3.75	0.425
21	-	-	-	-	-	3.58	0.43
22	-	-	-	-	-	3.76	0.48
23	-	-	-	-	-	3.89	0.485
24	-	-	-	-	-	3.87	0.49
25	-	-	-	-	-	3.87	0.51
26	-	-	-	-	-	4.16	0.52
27	-	-	-	-	-	4.13	0.51
28	-	-	-	-	-	4.00	0.52
29	-	-	-	-	-	4.12	0.525
30	-	-	-	-	-	4.26	0.58
31	-	-	-	-	-	4.27	0.585
32	-	-	-	-	-	4.24	0.59
33	-	-	-	-	-	4.42	0.62
34	-	-	-	-	-	4.54	0.67
35	-	-	-	-	-	4.85	0.70
36	-	-	-	-	-	4.75	0.71
37	-	-	-	-	-	4.70	0.74

IRON (MILD STEEL)

ID	RHO0	US1	UP1	US2	UP2	US3	UP3
38	-	-	-	-	-	4.90	0.76
39	-	-	-	-	-	5.00	0.77
40	-	-	-	-	-	4.98	0.78
41	-	-	-	-	-	5.05	0.785

US3 = 2.05 +3.79 UP KM/SEC.

TABLE II

ID	P1	V1/V0	P2	V2/V0	P3	V3/V0
1	12	0.9950	115	0.9444		
2	-	-	117	0.9435		
3	-	-	119	0.9425		
4	-	-	121	0.9415		
5	-	-	125	0.9395		
6	-	-	127	0.9385		
7	-	-	129	0.9376		
8	-	-	131	0.9366		
9	-	-	129	0.9376 •		
10					134	0.9312
11	-	-	-	-	136	0.9301
12	-	-	-	-	138	0.9263
13	-	-	-	-	139	0.9250
14	-	-	-	-	142	0.9247
15	-	-	-	-	142	0.9222
16	-	-	-	-	146	0.9204
17	-	-	-	-	145	0.9197
18	-	-	-	-	151	0.9145
19	-	-	-	-	159	0.9087
20	-	-	-	-	160	0.9089
21	-	-	-	-	160	0.9059
22	-	-	-	-	176	0.8940
23	-	-	-	-	179	0.8943
24	-	-	-	-	180	0.8927
25	-	-	-	-	187	0.8875
26	-	-	-	-	194	0.8888
27	-	-	-	-	191	0.8908
28	-	-	-	-	192	0.8866
29	-	-	-	-	195	0.8870
30	-	-	-	-	216	0.8757
31	-	-	-	-	218	0.8747
32	-	-	-	-	219	0.8730
33	-	-	-	-	233	0.8689
34	-	-	-	-	253	0.8598
35	-	-	-	-	273	0.8589
36	-	-	-	-	274	0.8551
37	-	-	-	-	284	0.8477
38	-	-	-	-	288	0.8475
39	-	-	-	-	305	0.8474
40	-	-	-	-	309	0.8450

41	-	-	-	-	313	0.8454

COMMENTS

1) SOURCE: LETHABY AND SKIDMORE
PRIVATE COMMUNICATION (1965)
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE D, ASSUMING 2UP = UFS.
3) V0I HAS CALCULATED FOR PURE IRON USING A LATTICE CONSTANT OF 2.86645 ANGSTROMS AT 20 DEG. CENTIGRADE.
A.C.A. MONOGRAPH NUMBER 5 (AMERICAN CRYSTALLOGRAPHIC ASSOCIATION, POLYCRYSTAL BOOK SERVICE 1963) 2ND. ED.
4. * THIS REPRESENTS THE ALPHA TO EPSILON TRANSITION POINT.
THIS IS THE AVERAGE VALUE OBTAINED FROM 21 EXPERIMENTS.

TABLE I

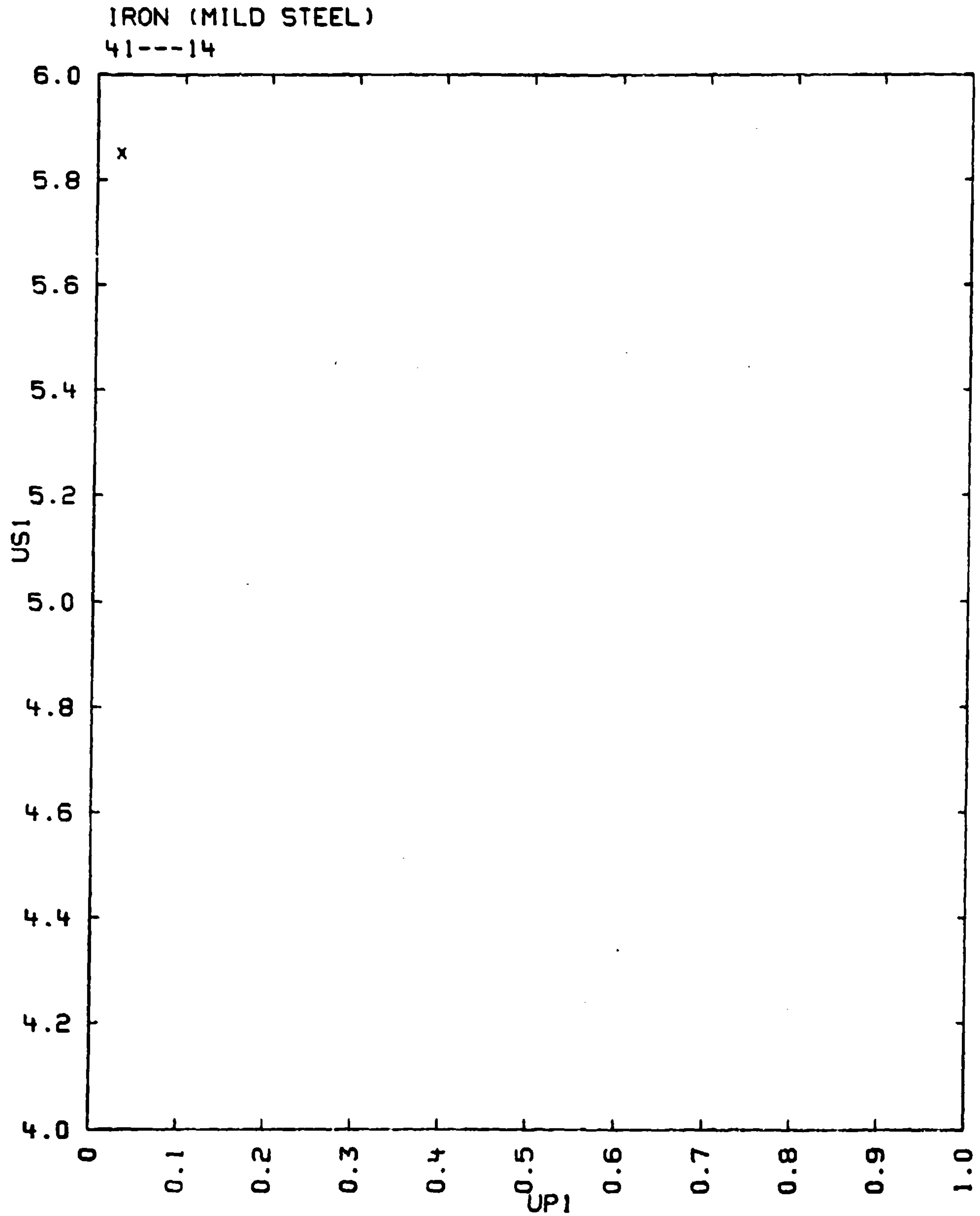

IRON (MILD STEEL)
41---14
US1
UP1
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

TABLE I

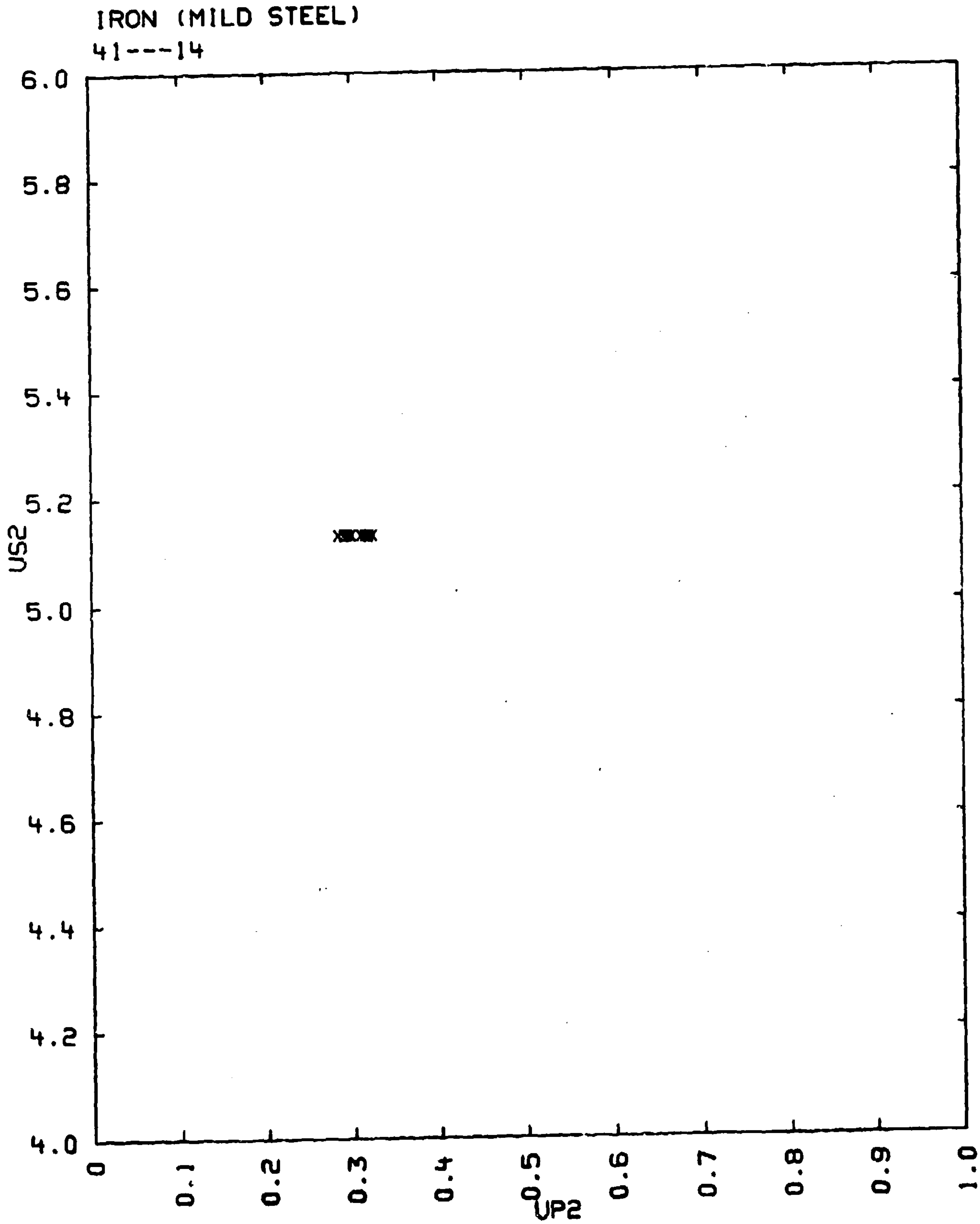
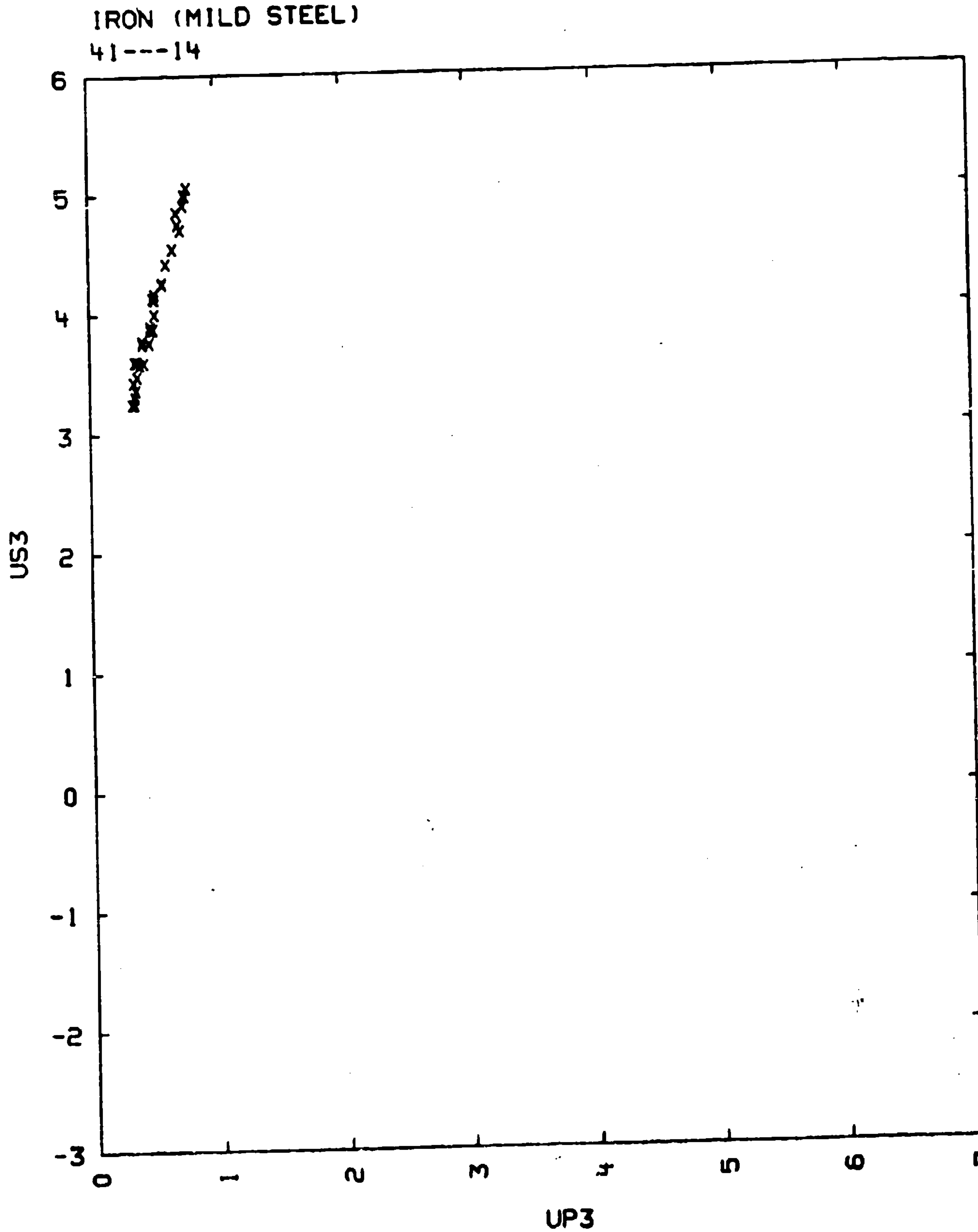

IRON (MILD STEEL)
41---14
US2
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP2

TABLE I



41---15
IRON

FE 95.6 WT. PERCENT
SI 4.0 WT. PERCENT
W 0.3-0.4 WT. PERCENT

VO = 0.1308 CC/G.
VOI= 0.1311 CC/G.

IN THE TABLE BELOW, THE DENSITY IS GIVEN IN G/CC, VELOCITIES ARE IN KM/SEC AND PRESSURE IN KILOBARS.

TABLE

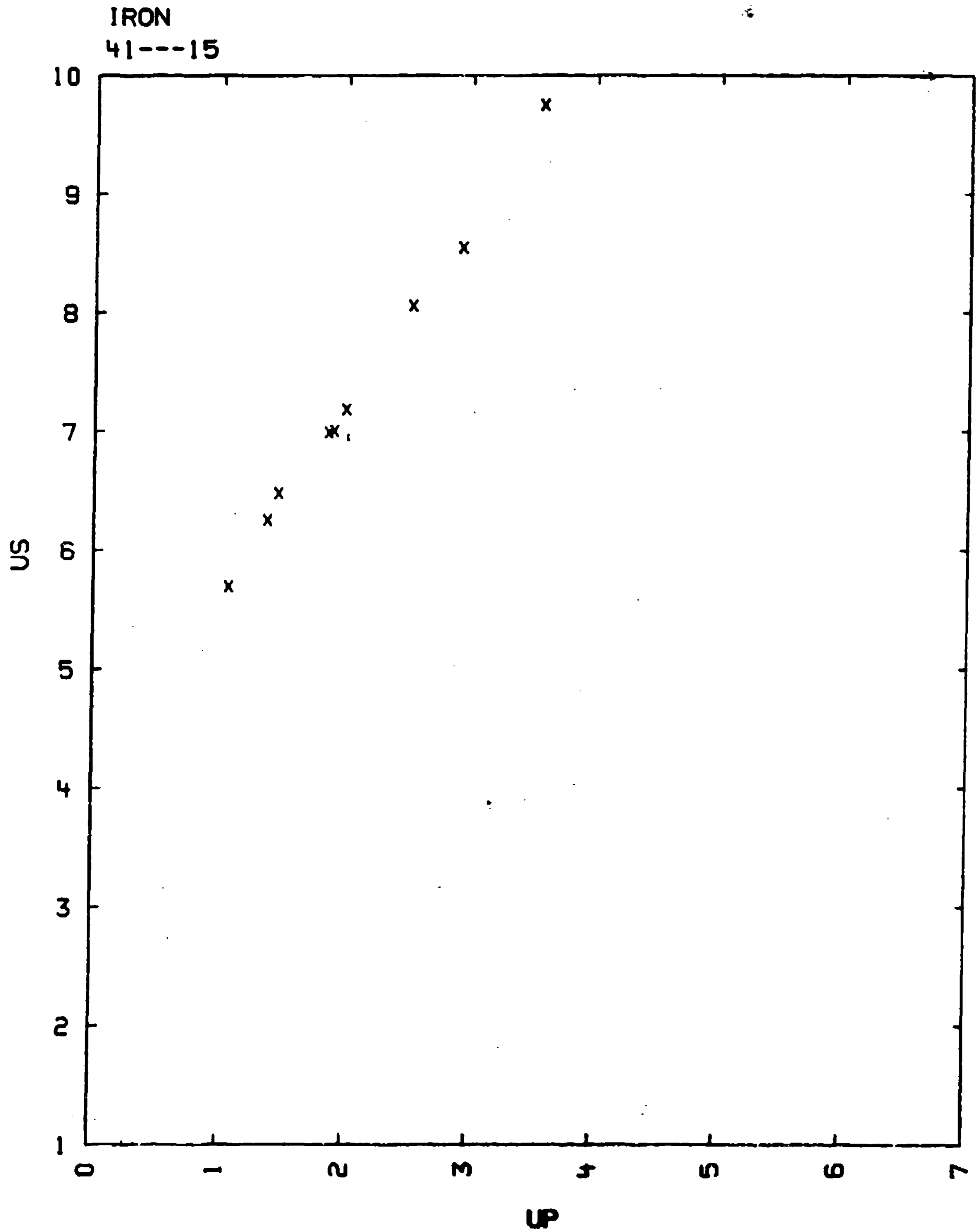
RHOO	US	UP	P	V/VO
7.646	5.684	1.074	467.	0.811
-	6.247	1.382	660.	0.779
-	6.474	1.469	727.	0.773
-	6.983	1.861	994.	0.734
-	6.996	1.902	1017.	0.728
-	7.177	1.997	1096.	0.722
-	8.056	2.525	1555.	0.687
-	8.541	2.922	1908.	0.658
-	9.742	3.568	2657.	0.634

US = 4.072 + 1.563*UP KM/SEC.   SIGMA US = 0.073 KM/SEC.

COMMENTS:

1) SOURCE: BALCHAN, A. S. AND COWAN, G. R.
JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 71, P. 3577, (1966)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS NICKEL
3) THE STANDARD HUGONIOT WAS OBTAINED FROM THE FOLLOWING EQUATION:
US = 4.612 + 1.523*UP - 0.0148 UP**2 KM/SEC
THIS EQUATION IS A COMPOSITE FIT OF DATA OBTAINED FROM WALSH, J. H., ET AL., MATERIAL 39---1, MCQUEEN, R. G. AND MARSH, S. P., MATERIAL 39---2 AND AL TSHULER, L. V., ET AL., MATERIAL 39---3.
4) THE INITIAL DENSITY (RHOO) IS A AVERAGE DENSITY.
5) A SHOCK TILT CORRECTION WAS APPLIED TO THE MEASURED SHOCK VELOCITIES FOR BOTH THE DRIVER PLATE AND SAMPLE.
6) VOI WAS CALCULATED WITH A BODY CENTERED LATTICE PARAMETER OF 2.8620 +OR- 5 ANGSTROM: W. B. PEARSON, HANDBOOK OF LATTICE SPACINGS AND STRUCTURES OF METALS, VOL. 4 (PERGAMON PRESS, NEW-YORK, 1958).
0.001 ANGSTROM WAS ADDED TO THE LATTICE PARAMETER OF FE-SI AS A CORRECTION FOR THE W CONTENT.

TABLE I



41---16
IRON POROUS

	POROUS	SOLID	MOLE PERCENT	
CU	0.001	0.12	MOLE PERCENT	
SI	0.13	0.01	-	-
CA CR NI MN CO	0.03	0.06	-	-
C	0.08-0.10		-	-
O	0.7	0.055	-	-
FE	REST	REST	-	-

PARTICLE SIZE 5 - 20 MICRONS

V0 = 0.1280 - 0.188 CC/G
V01= 0.1270 CC/G

THE TABLES LIST DENSITY IN G/CC. VELOCITIES IN KM/SEC AND PRESSURE IN KBAR. SEE COMMENT 7

TABLE I

RHO0	US1	UP1	P1	V1/V0	US2	UP2	P2	V2/V0
7.81	5.74	0.026	11.5	0.996	5.18	0.309	126.2	0.941
7.81	5.74	0.028	12.7	0.995	4.90	0.152	60.0	0.970
7.81	5.5	0.02	9.1	0.996	4.56	0.096	35.6	0.980

US =

TABLE II

RHO0	US1	UP1	P1	V1/V0	US2	UP2	P2	V2/V0
5.58	3.30	0.012	2.2	0.9964	1.78	0.504	51.1	0.718
5.58	3.01	0.012	1.9	0.9962	1.37	0.336	26.6	0.758
5.58	3.49	0.02	3.	0.996	1.80	0.523	53.6	0.712
5.58	3.36	0.021	3.9	0.9938	0.84	0.22	13.	0.75
5.56	2.61	0.018	2.6	0.9932	0.67	0.14	7.	0.81
5.63	3.11	0.02	3.	0.995	0.77	0.20	11.	0.74
5.42	3.30	0.016	2.8	0.9953	1.21	0.342	24.	0.72
5.65	2.83	0.011	1.8	0.9960	0.70	0.17	8.	0.77
5.50	3.05	0.012	2.1	0.9959	0.85	0.25	13.	0.72
5.33	2.73	0.014	2.0	0.9950	1.60	0.534	46.2	0.669

US2 = 0.217 + 2.92*UP KM/SEC
SIG US = 0.1 KM/SEC.

COMMENTS:

1) SOURCE: SCHMIDT, D.N. AND LINDE, R.K.
AIR FORCE WEAPONS LAB. REP.: CONTRACT NO. AF 29(601)-7236
SRI PROJECT: PGU-6127
STANFORD RES. INST., MENLO PARK, CALIFORNIA, U. S. A.
2) EXPERIMENTAL TECHNIQUE: 11 AND 12

DATA REDUCTION TECHNIQUE: C. WAVE PROFILES WERE BROAD BUT WERE
APROXIMATED BY A STEP FUNCTION MOVING AT
THE AVERAGE WAVE VELOCITY LISTED

3) THE FOOT OF THE ELASTIC WAVE IS BETWEEN 1 AND 10 PERCENT FASTER THAN THE AVERAGE VELOCITY LISTED. THE PROFILE AND AVERAGE VELOCITY OF THE PLASTIC (CRUSHING) WAVE WAS INFERRED FROM THE STRESS-TIME PROFILE AT THE GUAGE-SAMPLE INTERFACE AND THE REVERBERATION TIME OF AN ELASTIC RELEASE WAVE REFLECTING OF THE CRUSHING WAVE.
4) THE POROUS SAMPLES THAT YIELDED THE LAST TWO ENTRIES WERE HEATED TO 1100 DEG. F IN A HYDROGEN ATMOSPHERE. THE SHOCKWAVES THAT PASSED THROUGH THESE SAMPLES ALSO PRODUCED HIGHER COMPRESSIONS, INDICATING THE EFFECT OF ORGANIC AND METAL OXIDE IMPURITIES.
5) ALL POROUS SAMPLES WERE COMPACTED AND SINTERED AT 1600 DEG. F.
6) VOI WAS OBTAINED FROM A CUBIC CELL CONSTANT OF 2.8665 ANGSTROM WYCKOFF, CRYSTAL STRUCTURES, VOL. 1 (INTERSCIENCE PUBLISHERS, NEW YORK, 1963) 2ND. ED.
7) NOTE THAT THE SECOND WAVE PARAMETERS REPRESENT A CRUSHING CURVE. P IS AN EFFECTIVE LONGITUDINAL STRESS OBTAINED BY ASSUMING THAT THE SAMPLE IS A HOMOGENEOUS MEDIUM.

TABLE I

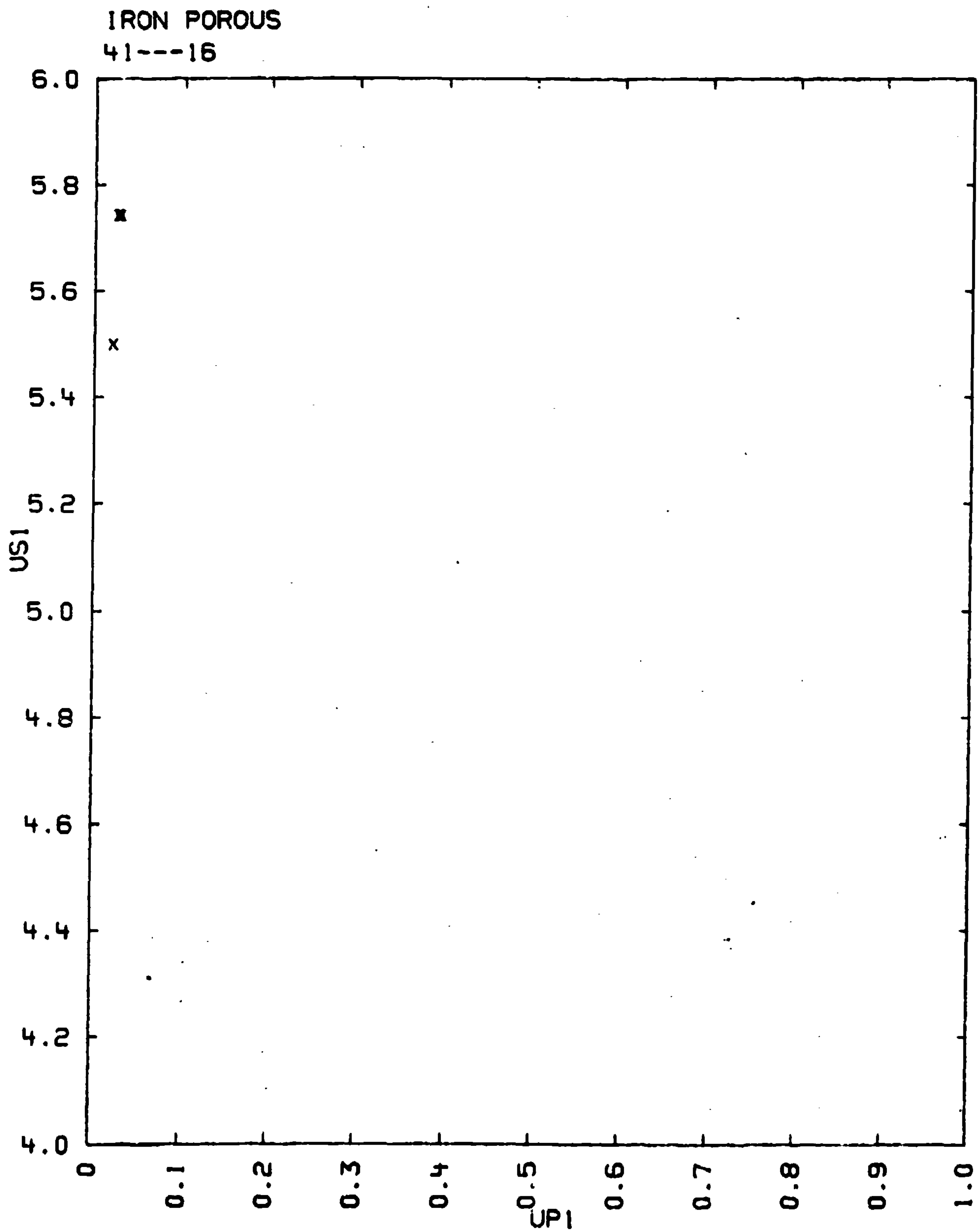

IRON POROUS
41---16
US1
UP1
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

TABLE I

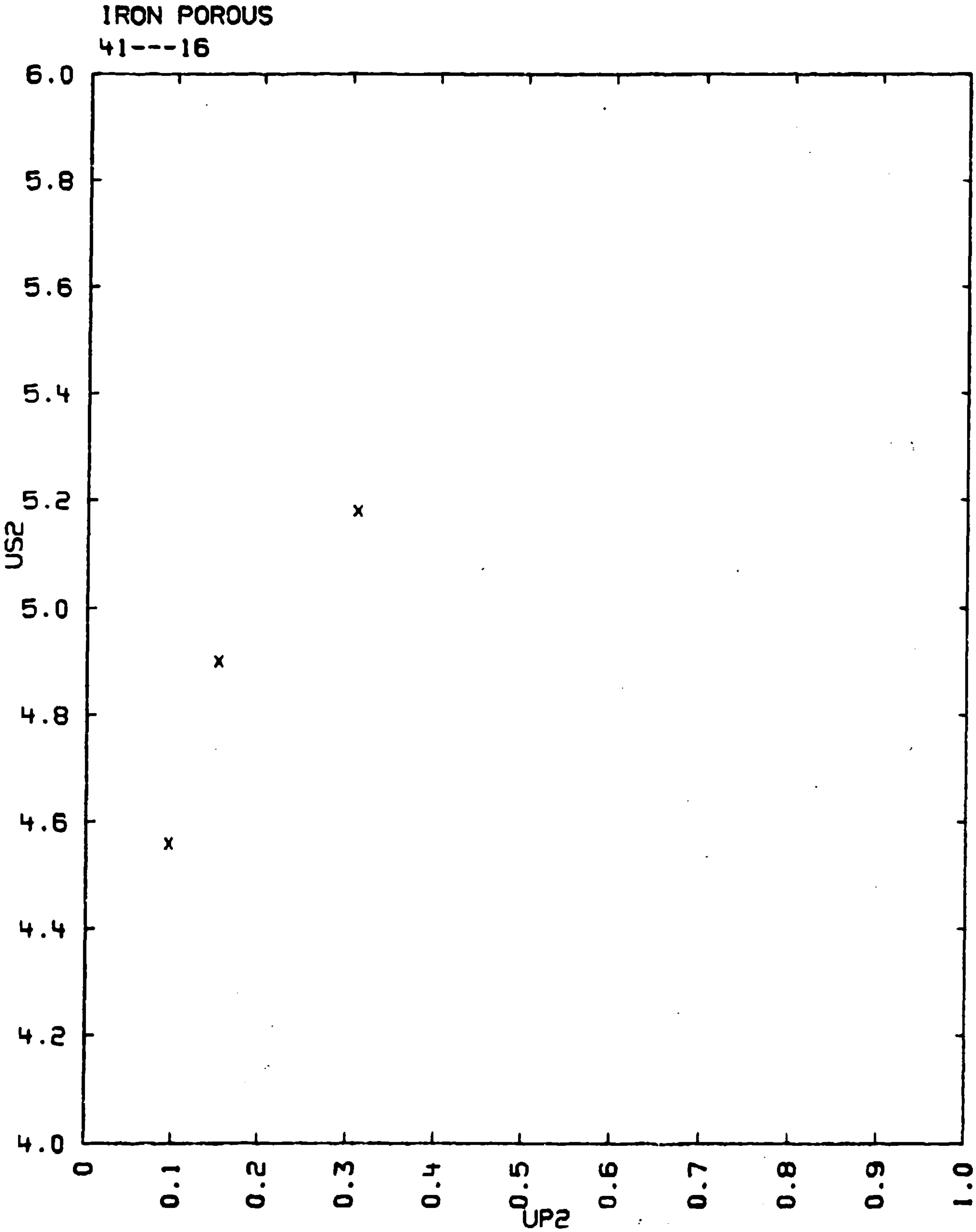
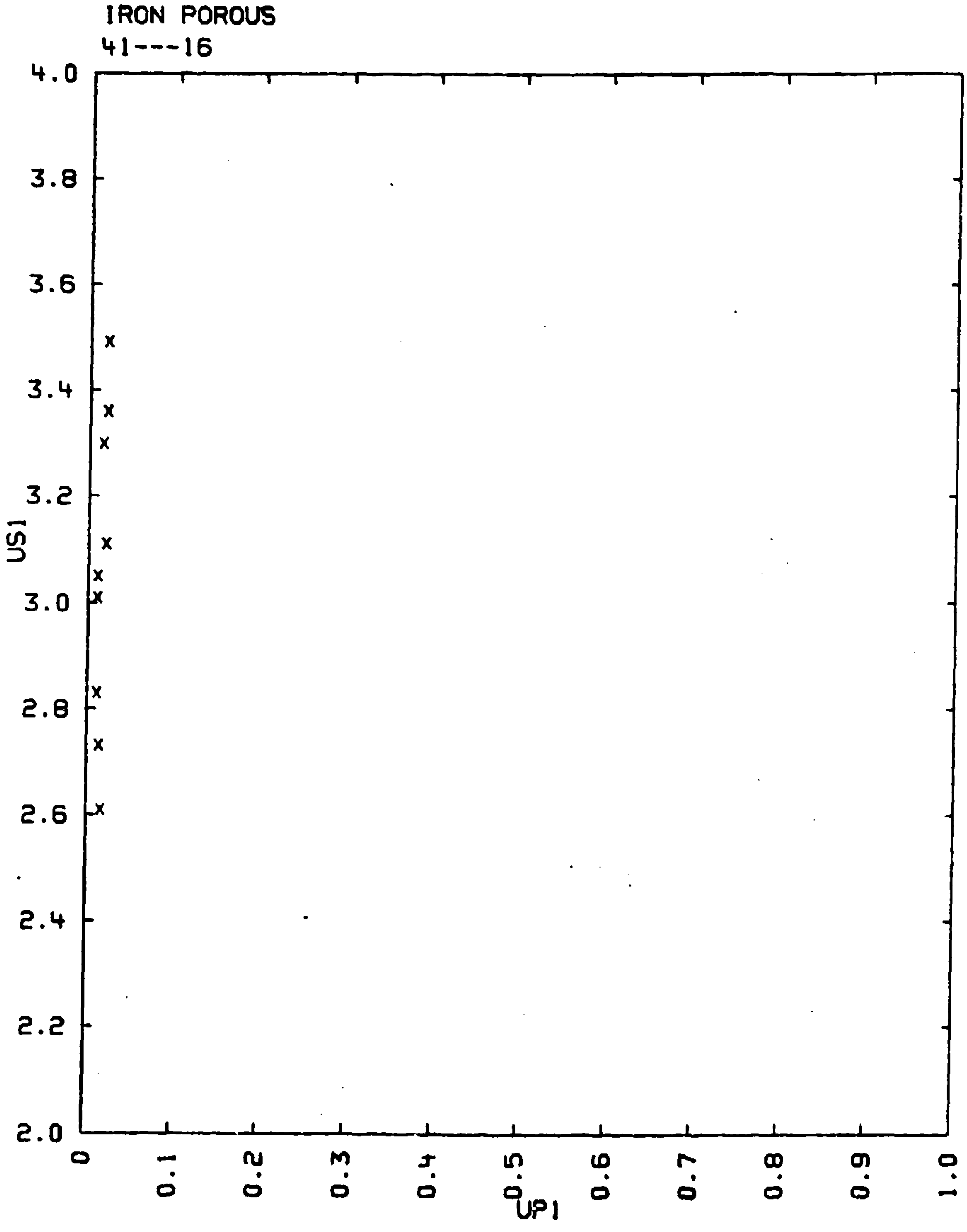
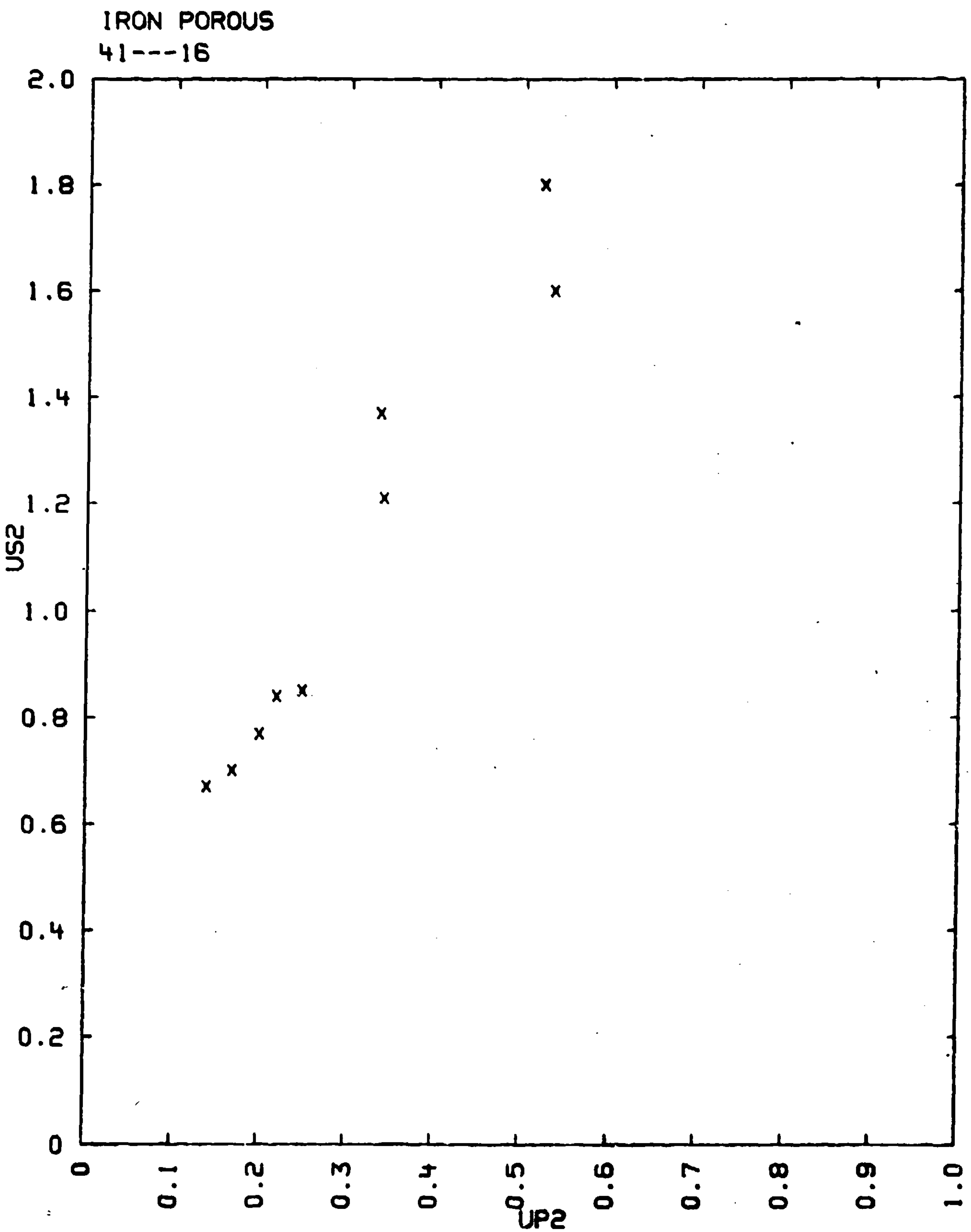

IRON POROUS
41---16
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
US2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP2

TABLE II



IRON POROUS
41---16
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
US1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP1

TABLE II


IRON POROUS
41---16
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
US2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP2

41---17
IRON

FE

V0 = 0.1271-0.3192 CC/G   CL = 5.94 KM/SEC   C0 = 4.59 KM/SEC
V0I = 0.1269 CC/G   CS = 3.26 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE I

---SAMPLE---					---STANDARD---
RHOO	US	UP	P	V/VO	MATERIAL
7.850	5.33	0.95	397.	0.8218	IRON
7.843	5.46	1.00	428.	0.8168	IRON
7.850	5.56	1.06	463.	0.8094	IRON
7.847	6.20	1.43	696.	0.7694	IRON
7.850	6.24	1.44	705.	0.7692	IRON
7.850	6.58	1.65	852.	0.7492	IRON
7.850	6.66	1.73	904.	0.7402	IRON
7.847	7.07	1.96	1087.	0.7228	IRON
7.850	7.08	1.98	1100.	0.7203	IRON
7.831	7.56	2.27	1344.	0.6997	IRON
7.847	7.81	2.44	1495.	0.6876	IRON
7.832	7.90	2.46	1522.	0.6886	IRON
7.809	8.09	2.61	1649.	0.6774	IRON
7.850	8.01	2.62	1647.	0.6729	IRON
7.847	8.24	2.72	1759.	0.6699	IRON
7.850	8.23	2.72	1757.	0.6695	IRON
7.850	8.32	2.73	1783.	0.6719	IRON
7.850	8.26	2.73	1770.	0.6695	IRON
7.868	8.31	2.82	1844.	0.6606	IRON
7.840	8.49	2.89	1924.	0.6596	IRON
7.842	8.81	3.06	2114.	0.6527	IRON
7.850	8.94	3.12	2190.	0.6510	IRON
7.850	8.99	3.18	2244.	0.6463	IRON
7.850	9.10	3.19	2279.	0.6495	IRON
7.860	9.24	3.35	2433.	0.6374	IRON
7.860	9.28	3.36	2451.	0.6379	IRON
7.855	9.51	3.59	2682.	0.6225	IRON

US = 3.574+1.920*UP-0.068*UP**2 KM/SEC HUGONIOT FIT MADE BY THE SOURCE
COMPARISON LEAST SQUARE FITS:
US = A0 + A1*UP + A2*UP**2 KM/SEC
A0 = 3.718 KM/SEC   SIG A0 = 0.082 KM/SEC
A1 = 1.781   SIG A1 = 0.079
A2 = -0.040 SEC/KM   SIG A2 = 0.018 SEC/KM
SIG US = 0.049 KM/SEC

TABLE II

-----SAMPLE-----					-----STANDARD-----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
7.861	4.84	0.57	217.	0.8822	2024 AL	6.48
7.840	5.39	0.97	410.	0.8200	2024 AL	7.23
7.840	5.37	0.97	408.	0.8194	2024 AL	7.23
7.840	5.41	0.99	420.	0.8170	2024 AL	7.27
7.840	5.58	1.06	464.	0.8100	2024 AL	7.41
7.865	5.52	1.06	460.	0.8080	2024 AL	7.41
7.857	5.48	1.07	461.	0.8047	2024 AL	[illegible]41
7.861	5.62	1.10	486.	0.8043	2024 AL	[illegible]9
7.862	5.97	1.30	610.	0.7822	2024 AL	7.68
7.861	6.24	1.46	716.	0.7660	2024 AL	8.19
7.861	6.93	1.85	1008.	0.7330	2024 AL	8.95
7.862	7.15	1.99	1119.	0.7217	2024 AL	9.[illegible]
7.861	7.47	2.07	1216.	0.7229	2024 AL	9.[illegible]
7.861	7.45	2.15	1259.	0.7114	2024 AL	9.54
7.861	7.80	2.34	1435.	0.7000	2024 AL	9.[illegible]
7.861	7.75	2.35	1432.	0.6968	2024 AL	[illegible]
7.861	8.17	2.58	1657.	0.6842	2024 AL	10.[illegible]
7.861	8.11	2.59	1651.	0.6806	2024 AL	10.36

US = A0 + A1*UP + A2*UP**2 KM/SEC
A0 = 3.764 KM/SEC SIG A0 = 0.132 KM/SEC
A1 = 1.682 SIG A1 = 0.18
A2 = 0.0115 SEC/KM SIG A2 = 0.054 SEC/KM
SIG US = 0.067 KM/SEC

TABLE III

-----SAMPLE-----					-----STANDARD-----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
7.861	5.67	1.18	526.	0.7919	921-T AL	7.48
7.861	5.66	1.18	525.	0.7915	921-T AL	7.48
7.861	6.35	1.54	769.	0.7575	921-T AL	8.21
7.861	6.33	1.54	766.	0.7567	921-T AL	8.21
7.861	6.86	1.86	1003.	0.7289	921-T AL	8.84
7.861	6.84	1.86	1000.	0.7281	921-T AL	8.84
7.861	7.58	2.26	1347.	0.7018	921-T AL	9.65
7.861	7.55	2.26	1341.	0.7007	921-T AL	9.65
7.861	8.17	2.56	1644.	0.6867	921-T AL	10.26
7.861	8.09	2.57	1634.	0.6823	921-T AL	10.26

US = A0 + A1*UP + A2*UP**2 KM/SEC
A0 = 3.651 KM/SEC SIG A0 = 0.20 KM/SEC
A1 = 1.697 SIG A1 = 0.22
A2 = 0.018 SIG A2 = 0.058 SEC/KM
SIG US = 0.037 KM/SEC

TABLE IV

-----SAMPLE-----					-----STANDARD-----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
7.864	5.28	0.99	409.	0.8114	CU	5.33
7.856	5.41	1.01	429.	0.8133	CU	5.37
7.859	5.49	1.06	457.	0.8069	CU	5.44
7.861	5.48	1.07	461.	0.8047	CU	5.45
7.864	5.52	1.10	478.	0.8007	CU	5.49
7.864	5.49	1.10	475.	0.7996	CU	5.49
7.861	5.95	1.30	608.	0.7815	CU	5.80
7.856	6.20	1.41	687.	0.7726	CU	5.97
7.861	6.58	1.70	879.	0.7416	CU	6.37
7.856	6.74	1.77	937.	0.7374	CU	6.48
7.861	6.74	1.78	943.	0.7359	CU	6.49
7.857	7.29	2.07	1186.	0.7160	CU	6.93
7.856	7.26	2.08	1186.	0.7135	CU	6.94
7.861	7.49	2.23	1313.	0.7023	CU	7.15
7.867	7.56	2.25	1338.	0.7024	CU	7.19
7.867	7.46	2.26	1326.	0.6971	CU	7.19
7.867	7.62	2.28	1367.	0.7008	CU	7.24
7.867	7.51	2.30	1359.	0.6937	CU	7.24
7.859	8.03	2.55	1609.	0.6824	CU	7.62
7.861	8.05	2.59	1639.	0.6783	CU	7.67
7.852	8.55	2.83	1900.	0.6690	CU	8.05

US = A0 + A1*UP + A2*UP**2 KM/SEC
A0 = 3.454 KM/SEC   SIG A0 = 0.138 KM/SEC
A1 = 1.971   SIG A1 = 0.167
A2 = -0.070 SEC/KM   SIG A2 = 0.046 SEC/KM
SIG US = 0.058 KM/SEC

TABLE V

-----SAMPLE-----					-----STANDARD-----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
7.882	5.22	0.90	370.	0.8276	TU-3 MO	3.70
7.882	5.17	0.91	371.	0.8240	TU-3 MO	3.70
7.882	5.34	0.98	412.	0.8165	TU-3 MO	3.81
7.861	6.18	1.39	675.	0.7751	TU-3 MO	4.34
7.861	6.17	1.39	674.	0.7747	TU-3 MO	4.34
7.861	6.25	1.42	698.	0.7728	TU-3 MO	4.38
7.861	6.40	1.54	775.	0.7594	TU-3 MO	4.53
7.861	6.39	1.54	774.	0.7590	TU-3 MO	4.53
7.861	7.74	2.37	1442.	0.6938	TU-3 MO	5.59
7.861	7.74	2.37	1442.	0.6938	TU-3 MO	5.59
7.861	7.74	2.37	1442.	0.6938	TU-3 MO	5.59
7.861	8.08	2.49	1582.	0.6918	TU-3 MO	5.76
7.861	8.66	2.97	2022.	0.6570	TU-3 MO	6.35

US = A0 + A1*UP + A2*UP**2
A0 = 3.263 KM/SEC   SIG A0 = 0.131 KM/SEC
A1 = 2.298   SIG A1 = 0.156
A2 = -0.163 SEC/KM   SIG A2 = 0.042 SEC/KM
SIG US = 0.054 KM/SEC

TABLE VI

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
7.002	3.21	0.57	128.	0.8224	CU	4.60
6.992	3.26	0.70	160.	0.7853	CU	4.75
7.001	3.37	0.70	165.	0.7923	CU	4.76
7.061	3.47	0.79	194.	0.7723	CU	4.87
6.965	3.57	0.85	211.	0.7619	CU	4.95
6.960	4.42	1.15	354.	0.7398	CU	5.38
6.945	5.29	1.43	525.	0.7297	CU	5.79
6.940	5.14	1.45	517.	0.7179	CU	5.80
6.988	5.42	1.57	595.	0.7103	CU	5.98
6.954	5.51	1.65	632.	0.7005	CU	6.08
7.025	6.14	1.77	763.	0.7117	CU	6.31
6.968	5.90	1.84	756.	0.6881	CU	6.35
6.986	5.92	1.86	769.	0.6858	CU	6.39
7.070	6.24	1.95	860.	0.6875	CU	6.55
6.913	6.29	2.01	874.	0.6804	CU	6.60
6.963	6.30	2.05	899.	0.6746	CU	6.65
6.979	6.43	2.09	938.	0.6750	CU	6.72
6.933	6.94	2.44	1174.	0.6484	CU	7.19
6.959	7.60	2.80	1481.	0.6316	CU	7.71
7.046	7.93	3.01	1682.	0.6204	CU	8.02
6.945	8.07	3.05	1709.	0.6221	CU	8.08
6.910	7.99	3.13	1728.	0.6083	CU	8.15

US =

TABLE VII

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
5.973	2.24	0.54	72.	0.7589	CU	4.48
5.893	2.44	0.65	95.	0.7336	CU	4.60
5.884	2.74	0.79	127.	0.7117	CU	4.76
5.913	3.03	0.94	168.	0.6898	CU	4.95
6.054	3.62	1.12	245.	0.6906	CU	5.20
6.041	4.02	1.25	304.	0.6891	CU	5.38
6.000	4.68	1.56	438.	0.6667	CU	5.79
6.050	4.97	1.70	511.	0.6579	CU	5.98
6.104	5.50	2.00	671.	0.6364	CU	6.39
5.920	5.73	2.19	743.	0.6178	CU	6.60
5.919	5.91	2.28	798.	0.6142	CU	6.72
5.820	6.62	2.63	1013.	0.6027	CU	7.19
6.080	7.22	2.98	1308.	0.5873	CU	7.71
6.055	7.58	3.33	1520.	0.5607	CU	8.15

US =

TABLE VIII

RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
----------------	-------	SAMPLE	-------	----------------	-----STANDARD-----	
4.808	1.77	0.59	50.	0.6667	CU	4.48
4.629	1.93	0.72	84.	0.6269	CU	4.60
4.697	2.35	0.86	95.	0.6340	CU	4.76
4.761	2.48	0.96	113.	0.6123	CU	4.87
4.532	2.44	1.06	117.	0.565[illegible]	CU	4.95
4.662	2.76	1.13	145.	0.5903	CU	5.05
4.650	4.23	1.74	342.	0.58[illegible]7	CU	5.79
4.744	2.93	1.26	175.	0.5700	CU	5.20
4.851	3.20	1.43	213.	0.5531	CU	5.38
4.720	3.99	1.77	333.	0.556[illegible]	CU	5.80
4.680	4.29	1.91	383.	0.5548	CU	5.98
4.827	4.57	1.96	432.	0.5711	CU	6.08
4.729	5.05	2.19	523.	0.5663	CU	6.35
4.908	5.08	2.19	546.	0.5689	CU	6.39
4.901	5.27	2.38	615.	0.5484	CU	6.60
4.734	5.33	2.44	616.	0.5422	CU	6.65
4.619	5.43	2.51	630.	0.5378	CU	6.72
4.880	6.07	2.85	844.	0.5305	CU	7.19
4.770	7.16	3.53	1206.	0.5070	CU	8.02
4.958	7.35	3.58	1305.	0.5129	CU	8.15

US =

TABLE IX

RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
----------------	-------	SAMPLE	-------	----------------	-----STANDARD-----	
3.313	1.41	0.64	30.	0.5461	CU	4.48
3.222	1.50	0.94	45.	0.3733	CU	4.73
3.472	2.14	1.05	78.	0.5093	CU	4.87
3.651	1.97	1.07	77.	0.4569	CU	4.88
3.388	1.97	1.18	79.	0.4010	CU	4.98
3.380	2.30	1.24	96.	0.4609	CU	5.05
3.323	2.83	1.65	155.	0.4170	CU	5.45
6.538	3.46	1.95	441.	0.4364	CU	5.80
3.219	3.59	1.96	227.	0.4540	CU	5.79
3.351	3.49	2.01	235.	0.4241	CU	5.85
3.716	4.05	2.16	325.	0.4667	CU	6.08
3.494	4.65	2.37	385.	0.4903	CU	6.31
3.310	4.45	2.48	365.	0.4427	CU	6.37
3.133	4.24	2.51	333.	0.4080	CU	6.35
3.260	4.73	2.70	418.	0.4292	CU	6.60
3.317	4.87	2.73	441.	0.4394	CU	6.65
3.260	5.62	3.16	579.	0.4377	CU	7.13
3.323	5.63	3.16	591.	0.4387	CU	7.15
3.486	6.34	3.47	767.	0.4527	CU	7.57
3.424	6.29	3.64	786.	0.4197	CU	7.71
3.443	6.82	3.95	928.	0.4208	CU	8.07

IRON

RHOO	US	UP	P	V/VO	MATERIAL US(ST)

US =

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES. HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII
2) EXPERIMENTAL TECHNIQUE: B
DATA REDUCTION TECHNIQUE: A (TABLE I), B (THE REST)
3) VOI WAS CALCULATED FROM WYCKOFF, CRYSTAL STRUCTURES (JOHN WILEY AND SONS, N.Y., 1963) V. 1
4) TABLE I IS THE HUGONIOT OBTAINED FROM SYMMETRIC IMPACT. TABLES II THROUGH V CHECK THE INTERNAL CONSISTENCY OF THE OTHER STANDARD HUGONIOTS OBTAINED WITH SYMMETRIC IMPACTS.
5) THE GRUNEISEN GAMMA OF 1.69 (=GAM) WITH THE ASSUMPTION THAT RHOO.GAM = CONSTANT REPRESENTS THE BEHAVIOR OF THE POROUS SAMPLES. ALSO GIVEN ARE (DV/DT)/V = 3.51E+5 PER DEG. AND CP = 0.448 JOULES PER G. DEG.
6) HUGONIOT ELASTIC LIMIT 15. - 14. KBAR (FINE - COARSE GRAIN; HARD)
HUGONIOT ELASTIC LIMIT 11. - 9. KBAR (- - - - ; SOFT)
7) THE 921-T AL PLATE STOCK USED TO OBTAIN THE CROSS CHECK DATA IN TABLE III IS SLIGHTLY POROUS

TABLE I

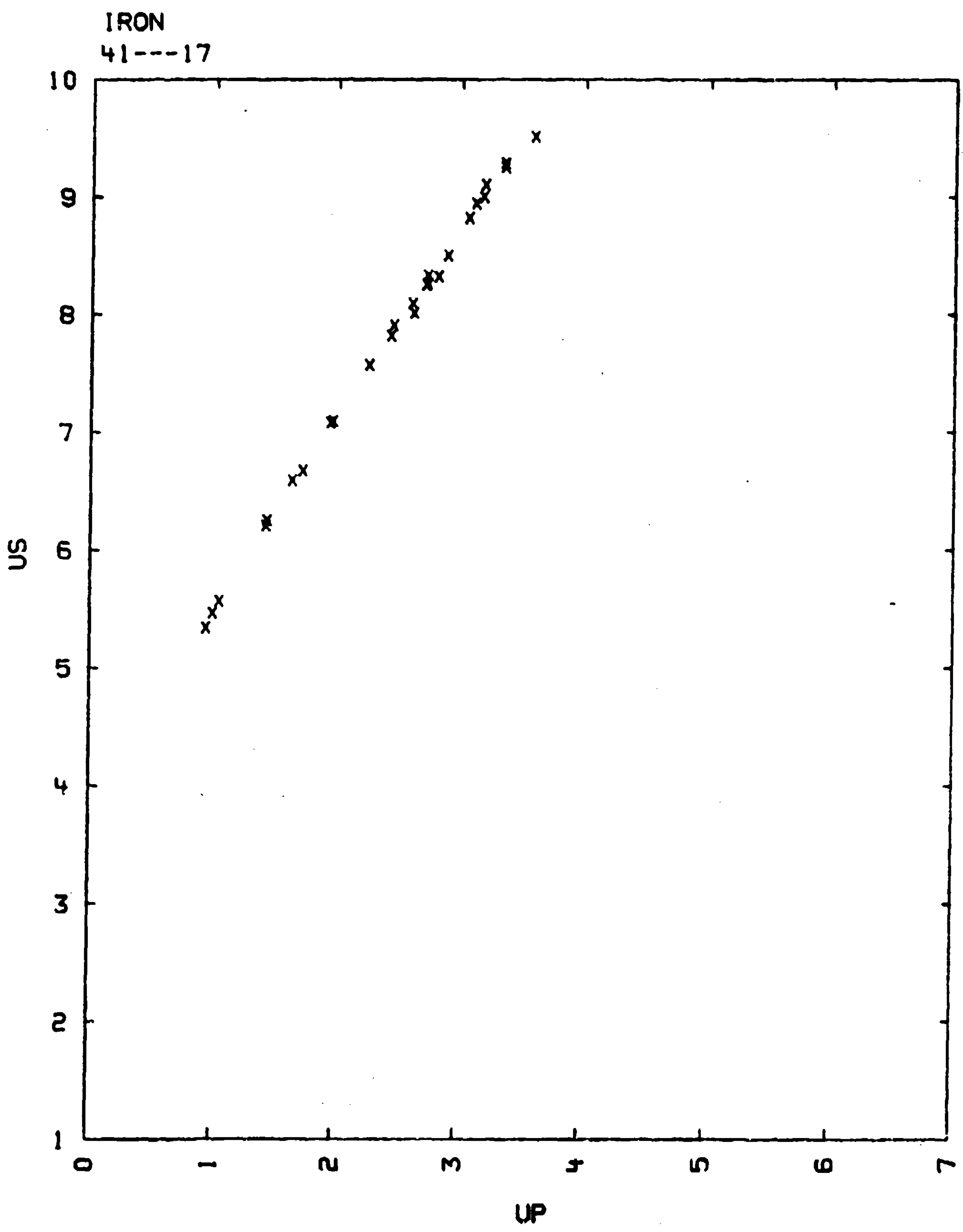
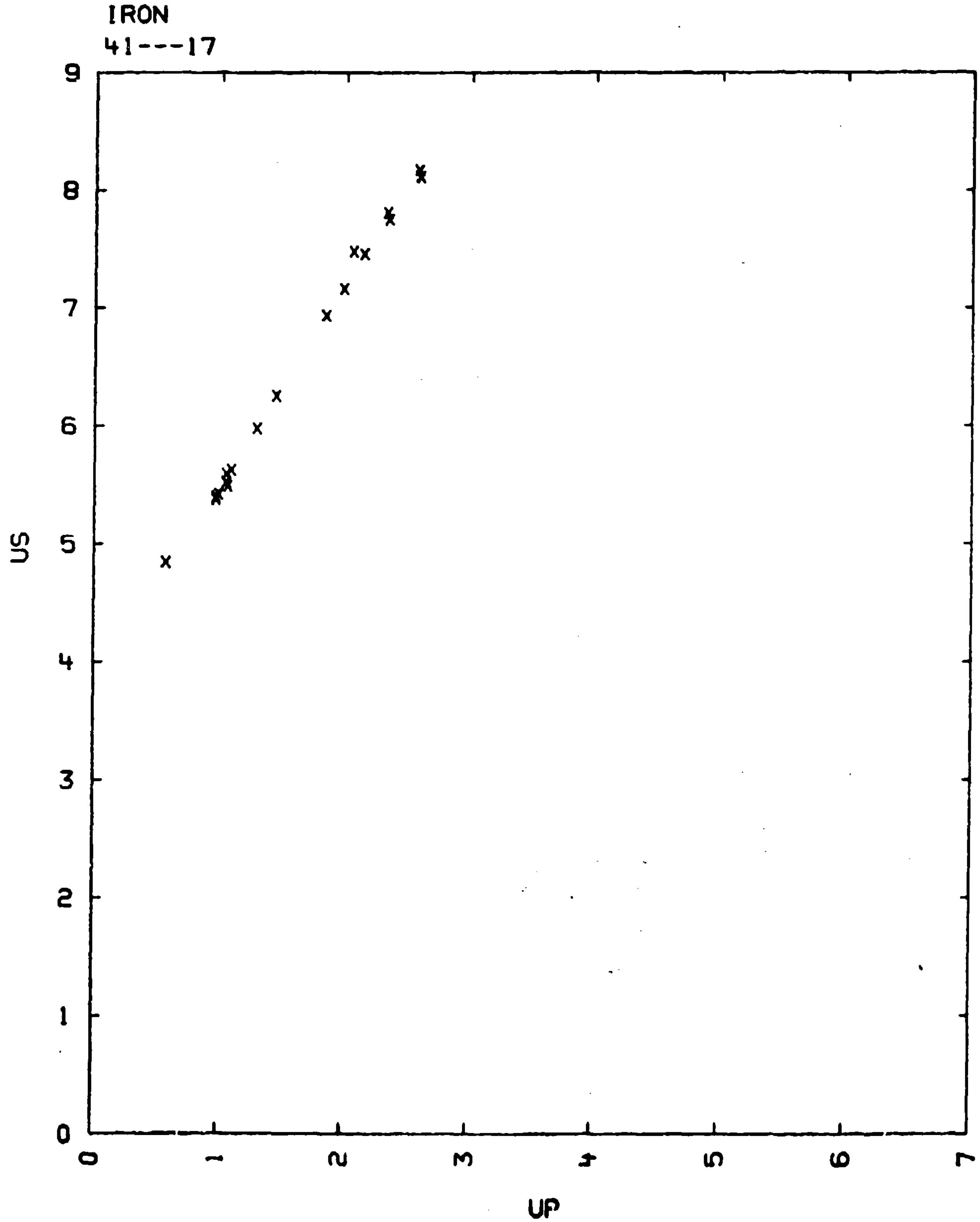


TABLE II



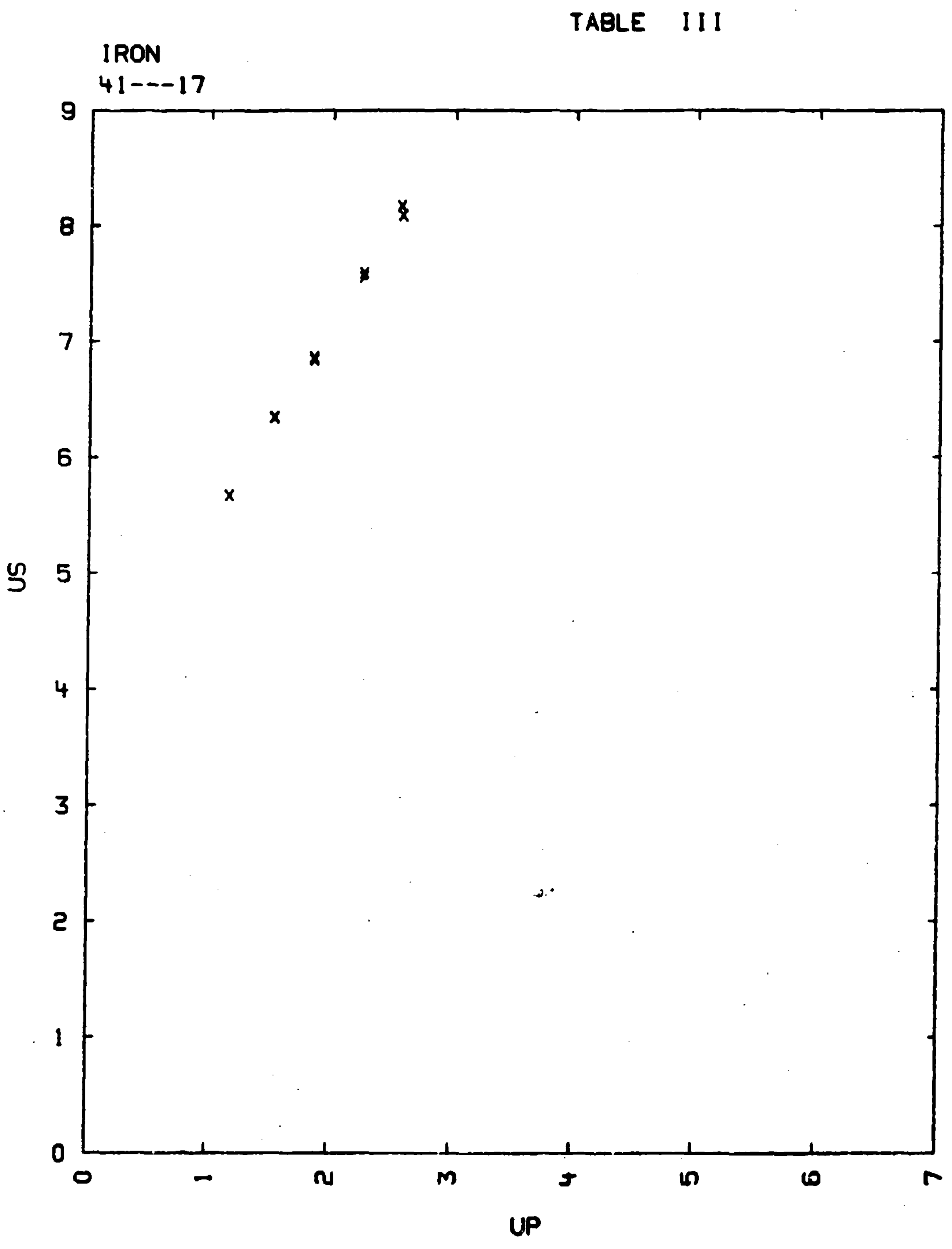


TABLE III
IRON
41---17
US
UP
0
1
2
3
4
5
6
7
8
9

TABLE IV

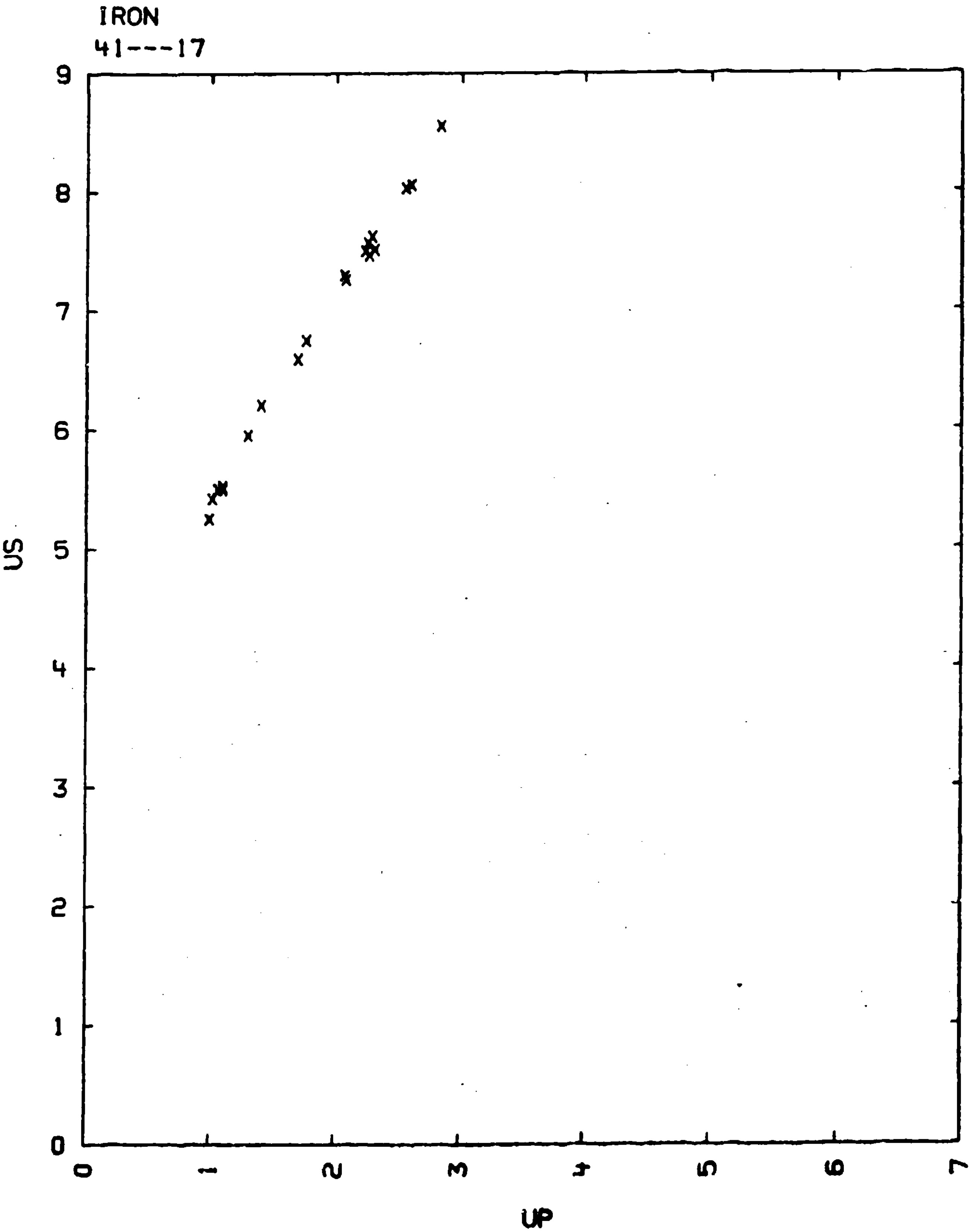


TABLE V

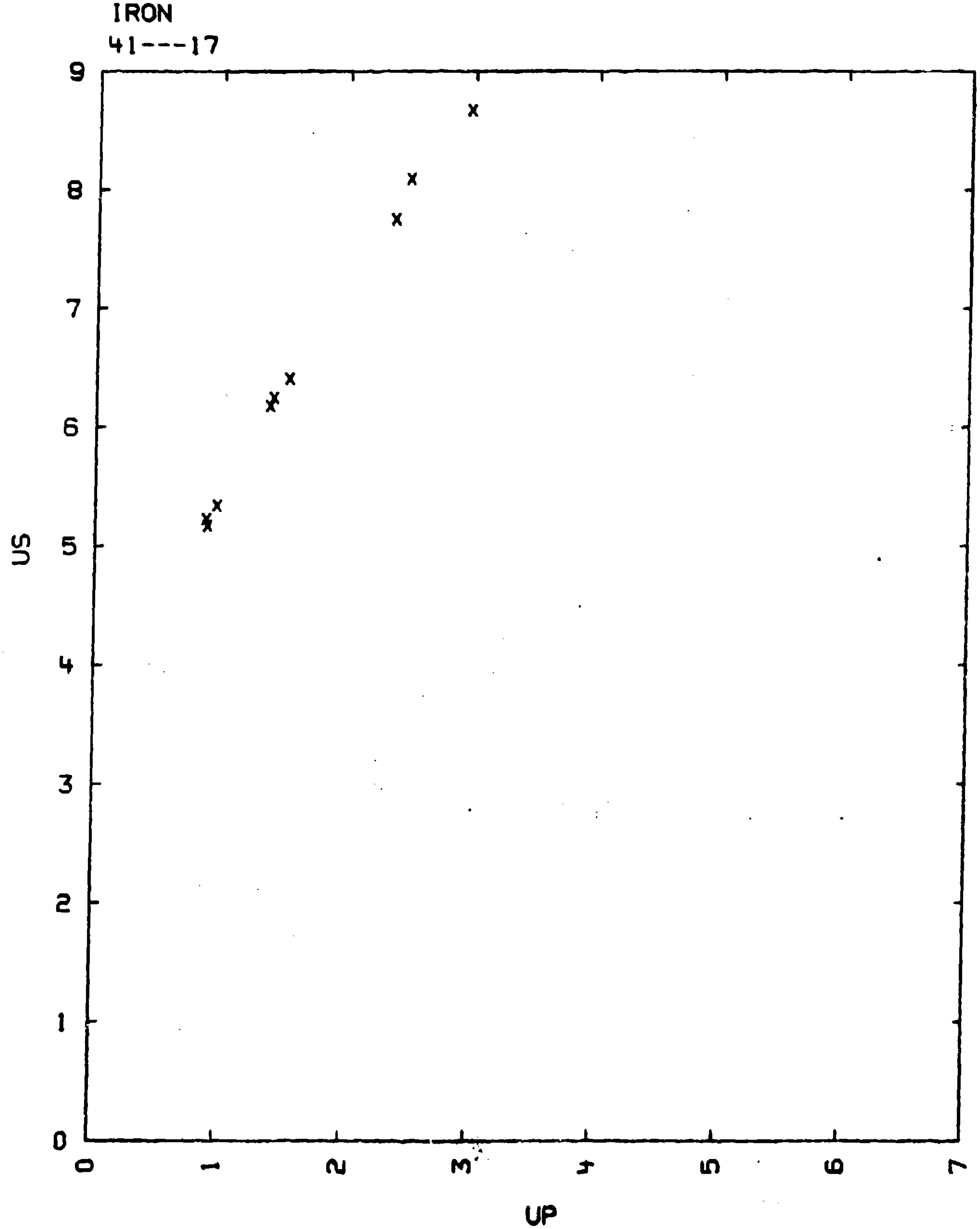


TABLE VI

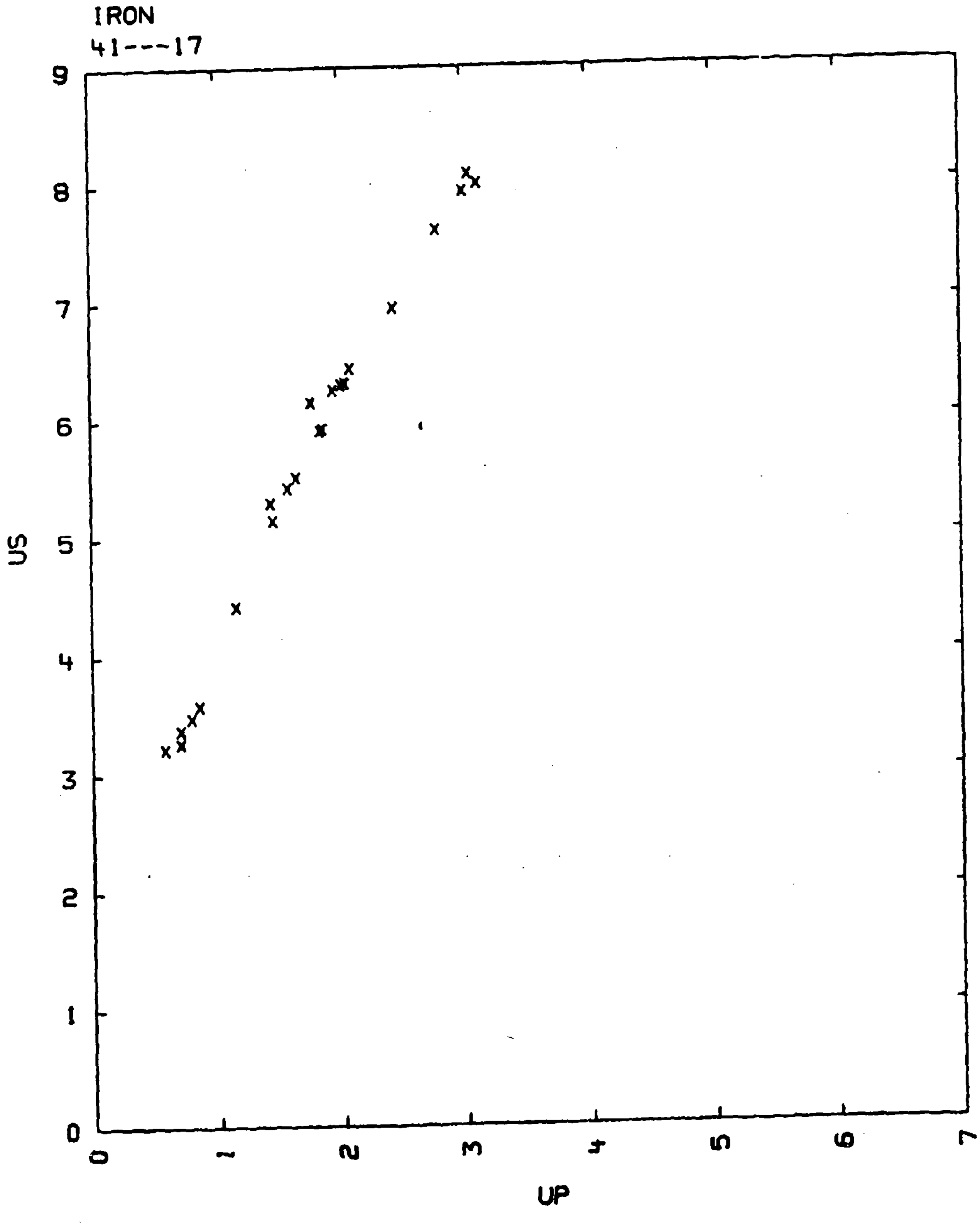


TABLE VII

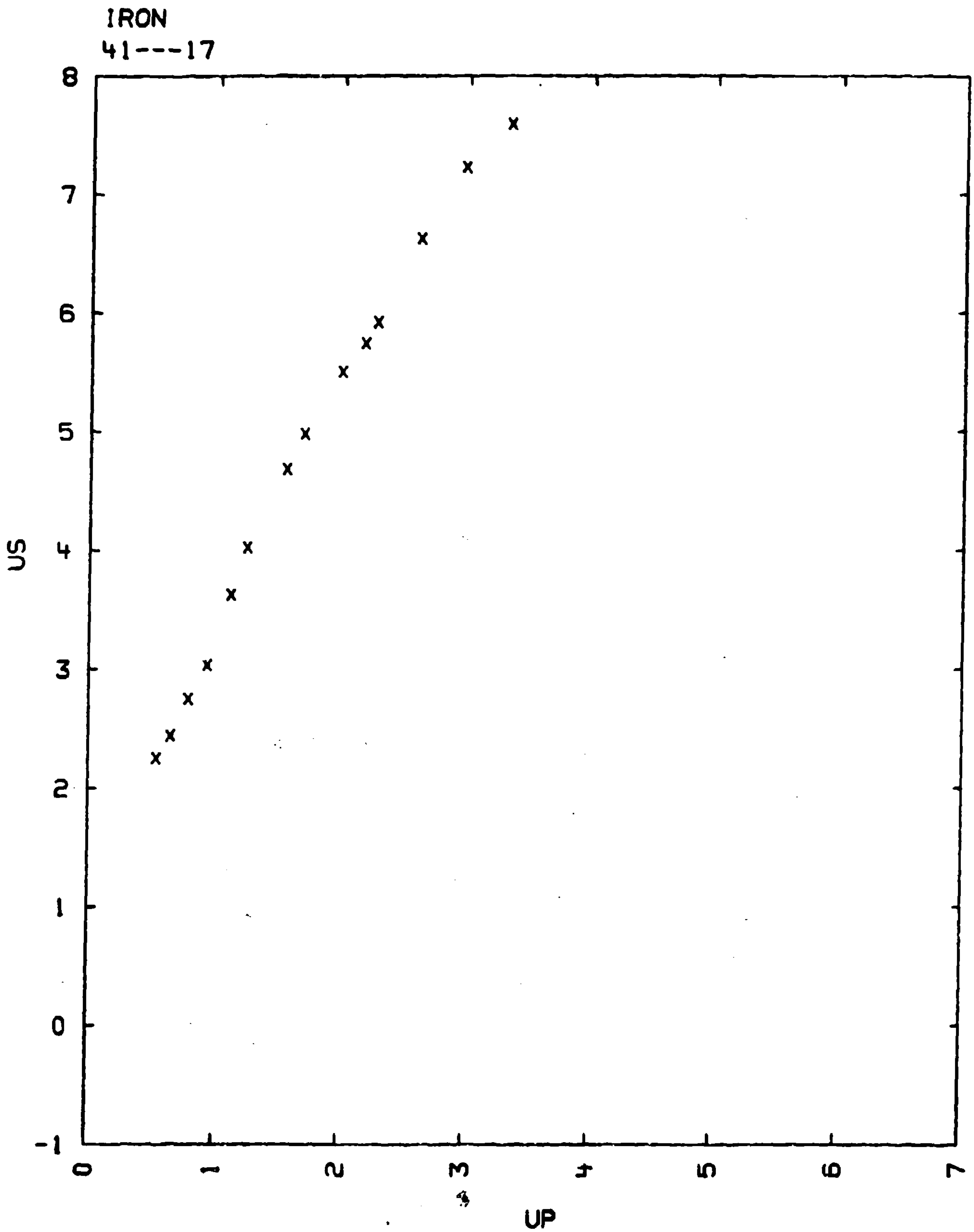


TABLE VIII

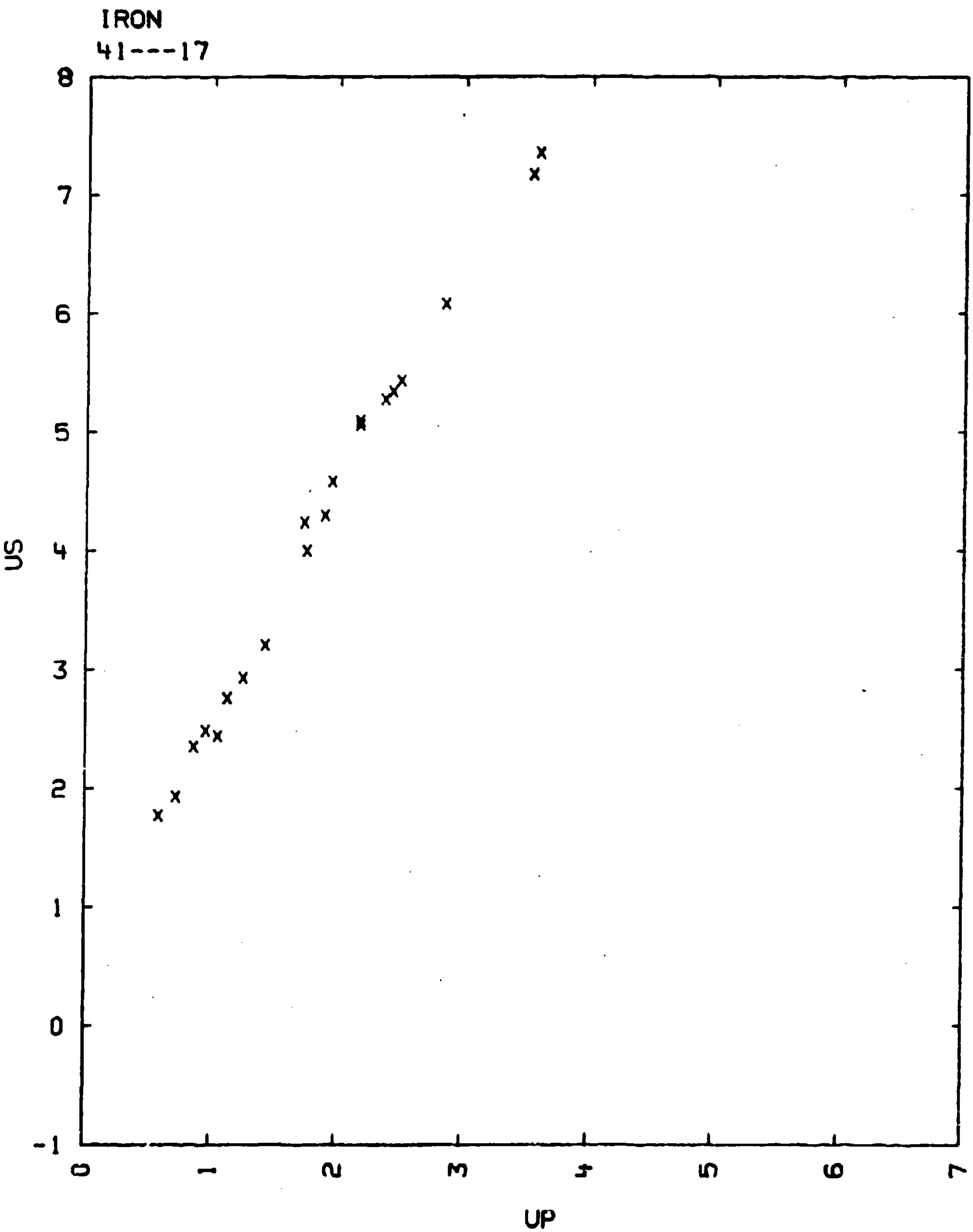
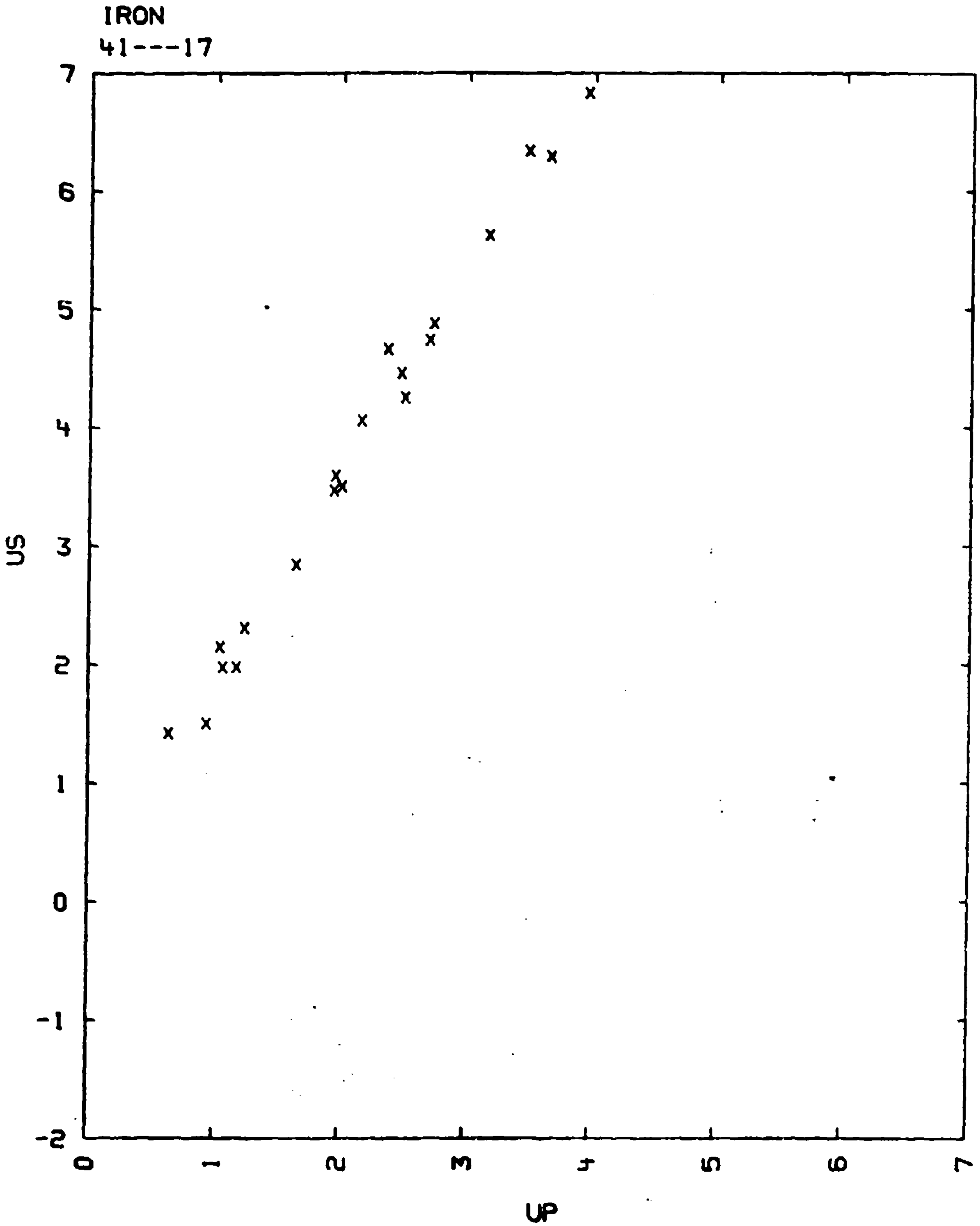


TABLE IX



42---1
PALLADIUM

PD 99.8 PER CENT OR GREATER

V0 = 0.08368 CC/G.
V01 = 0.08163 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURE IN KILOBARS, AND DENSITY IN G/CC.

TABLE

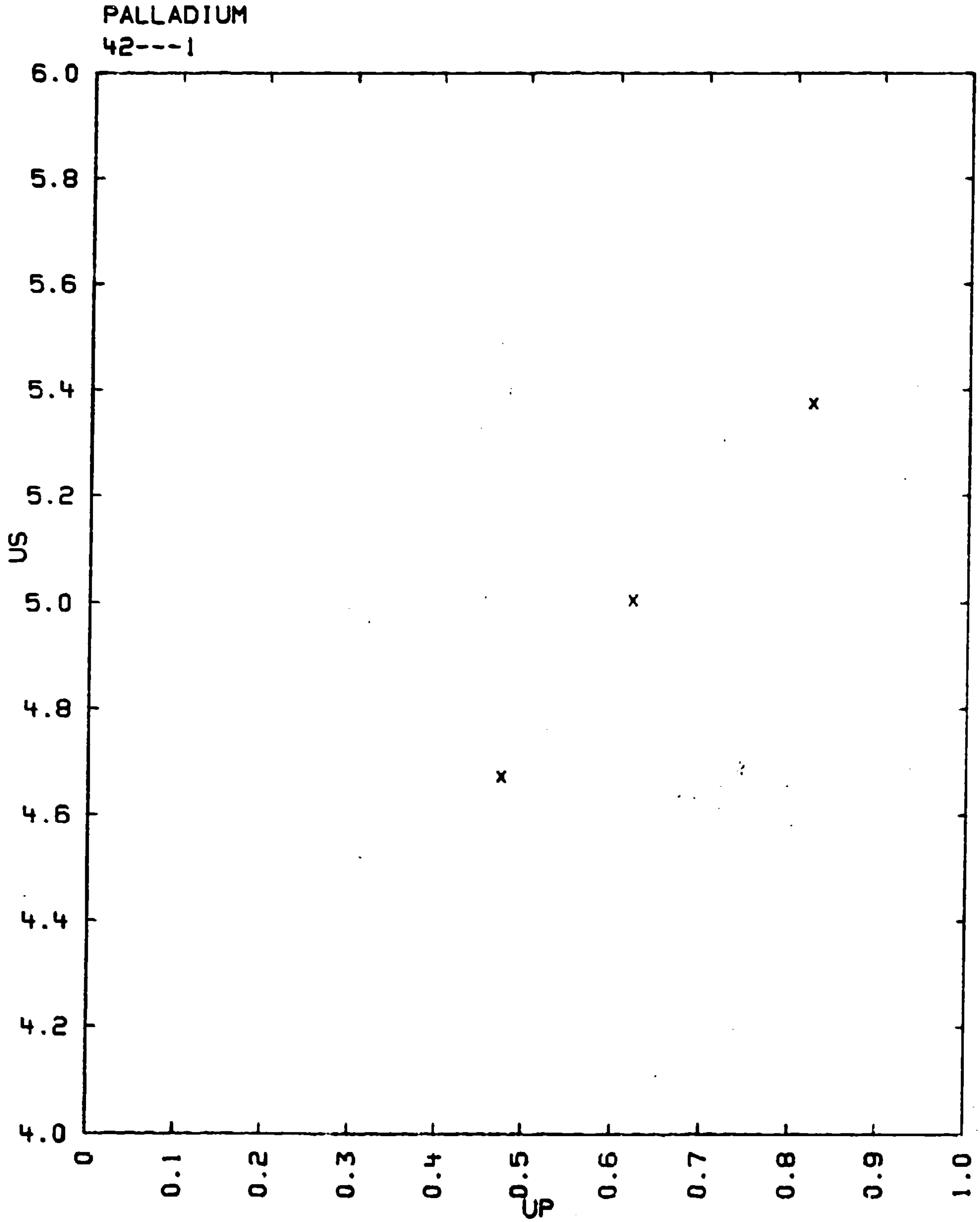
RHO0	US	UP	P	V/V0
11.95	4.673	0.4728	262.5	0.8988
-	5.004	0.6200	372	0.8761
-	5.374	0.8219	531	0.8471

US = 3.742 + 1.998 UP KM/SEC   SIGMA US = 0.6 PERCENT

COMMENTS:

1) SOURCE: WALSH, J.M., RICE, M.H., MCQUEEN, R.G. AND YARGER, F.L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 3 PER CENT IN COMPRESSION AT A GIVEN PRESSURE.
4) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS

TABLE I


PALLADIUM
42---1
US
UP
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

42---2
PALLADIUM

PD 99.5 PERCENT OR GREATER

V0 = 0.0833 CC/G. CL = 4.57 KM/SEC. C0 = 3.90 KM/SEC.
V0I = 0.08307 CC/G. CS = 2.06 KM/SEC. CB = 3.80 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC.,
PRESSURE IN KILOBARS AND DENSITIES IN G/CC.

TABLE

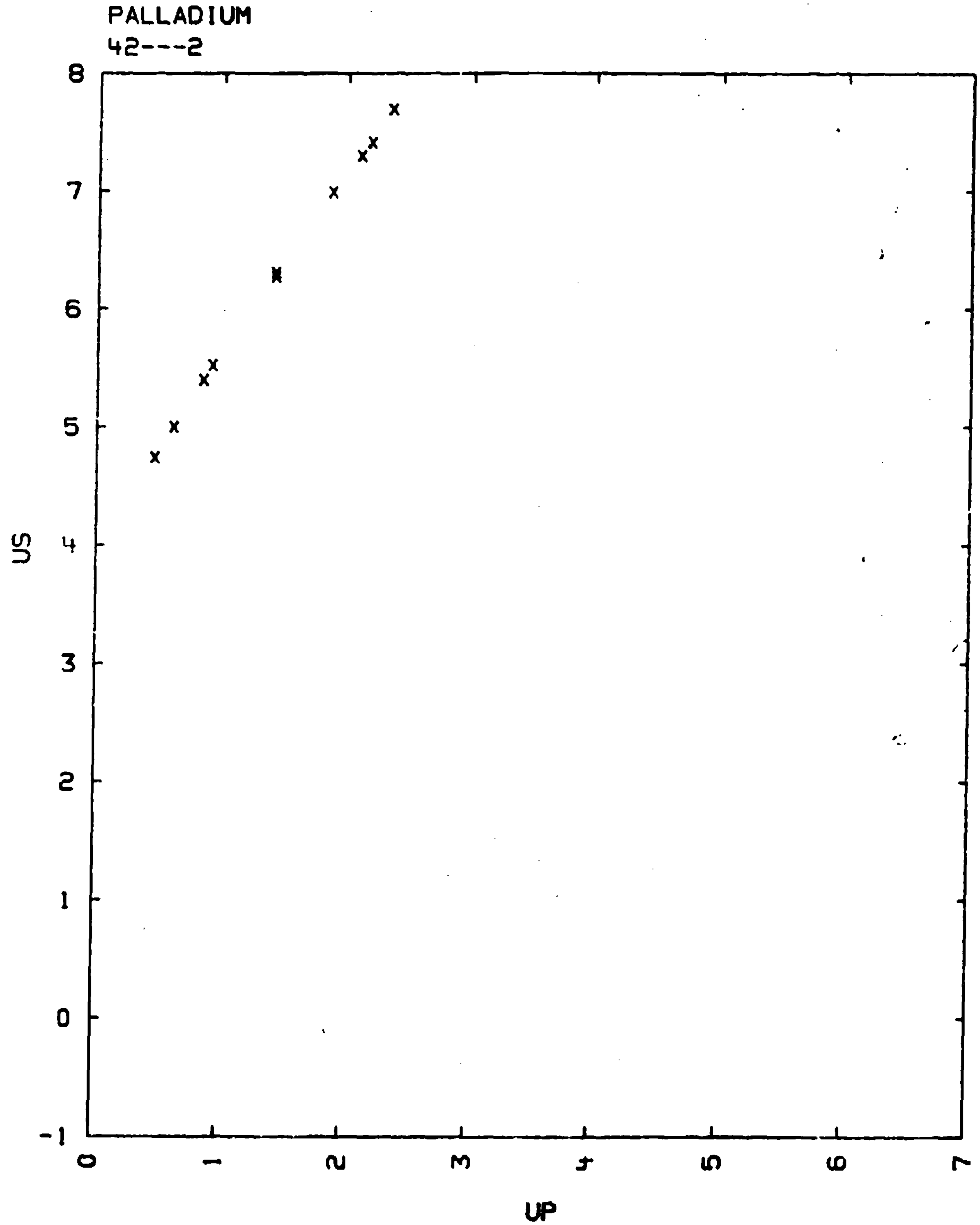
SAMPLE					STANDARD	
RHO0	US	UP	P	V/V0	RHO0	US
12.00	4.737	0.467	265.5	0.9014	8.932	4.764
-	4.992	0.619	370.8	0.8760	8.934	5.024
-	5.396	0.856	554.3	0.8414	-	5.426
12.01	5.522	0.927	614.8	0.8321	-	5.548
12.00	6.271	1.435	1079.9	0.7712	-	6.387
-	6.305	1.435	1085.7	0.7724	-	6.393
-	6.304	1.440	1089.3	0.7715	-	6.400
-	6.981	1.885	1579.1	0.7300	-	7.133
-	7.294	2.108	1845.1	0.7110	-	7.494
-	7.398	2.196	1949.5	0.7032	-	7.632
-	7.691	2.361	2179.0	0.6930	-	7.910

US = 4.063 + 1.538 UP. SIG.US = 0.03 KM/SEC.

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
REPORT NO. GMX-6-566, PP. 51-62 (1964)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS COPPER
3) THE COPPER MATERIAL LINEAR EQUATION OF STATE IS REPRESENTED BY
US = 3.958 + 1.497 UP KM/SEC.
THE PARTIAL (DE/DP)V = 0.0562 CUBIC CM.
4) V0I WAS TAKEN FROM A.I.P. HANDBOOK (MCGRAW HILL BOOK CO.)
2ND ED.

TABLE I



42---3
PALLADIUM

PD

VO = 0.832 CC/G
VOI = 0.831 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN KM/SEC, AND PRESSURE IN KILOBARS.

TABLE

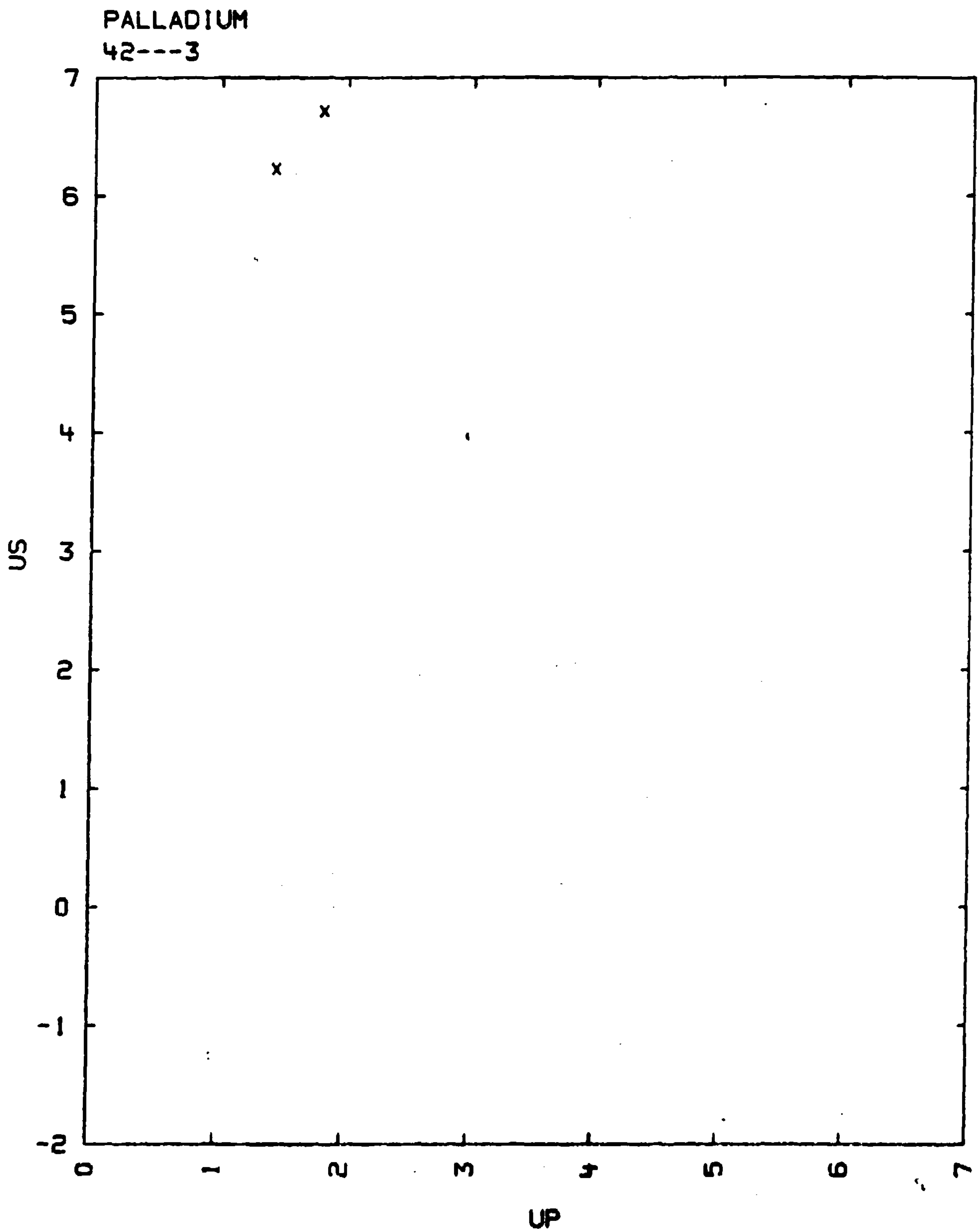
RHOO	US	UP	P	V/VO
12.02	6.08	1.44	1050	0.764
-	6.22	1.43	1086	0.770
-	6.71	1.81	1460	0.730

US = 4.02 +1.49 UP KM/SEC
SIGMA US = 0.110 KM/SEC

COMMENTS:

1) SOURCE: LUNDBERG, LENNART.
PRIVATE COMMUNICATION
RESEARCH INSTITUTE OF NATIONAL DEFENSE, STOCKHOLM, SWEDEN
2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION TECHNIQUE B.
3) THE VALUE OF VOI WAS OBTAINED FROM A. TAYLOR AND BRENDA J. KAGLE, CRYSTALLOGRAPHIC DATA ON METAL AND ALLOY STRUCTURES (DOVER PUBLICATIONS, INC., NEW YORK, N. Y., 1963).

TABLE I



42---4
PALLADIUM

PD

VO = 0.08333 CC/G CL = 4.57 KM/SEC CO = 3.90 KM/SEC
VOI = 0.08328 CC/G CS = 2.06 KM/SEC CB = 3.80 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

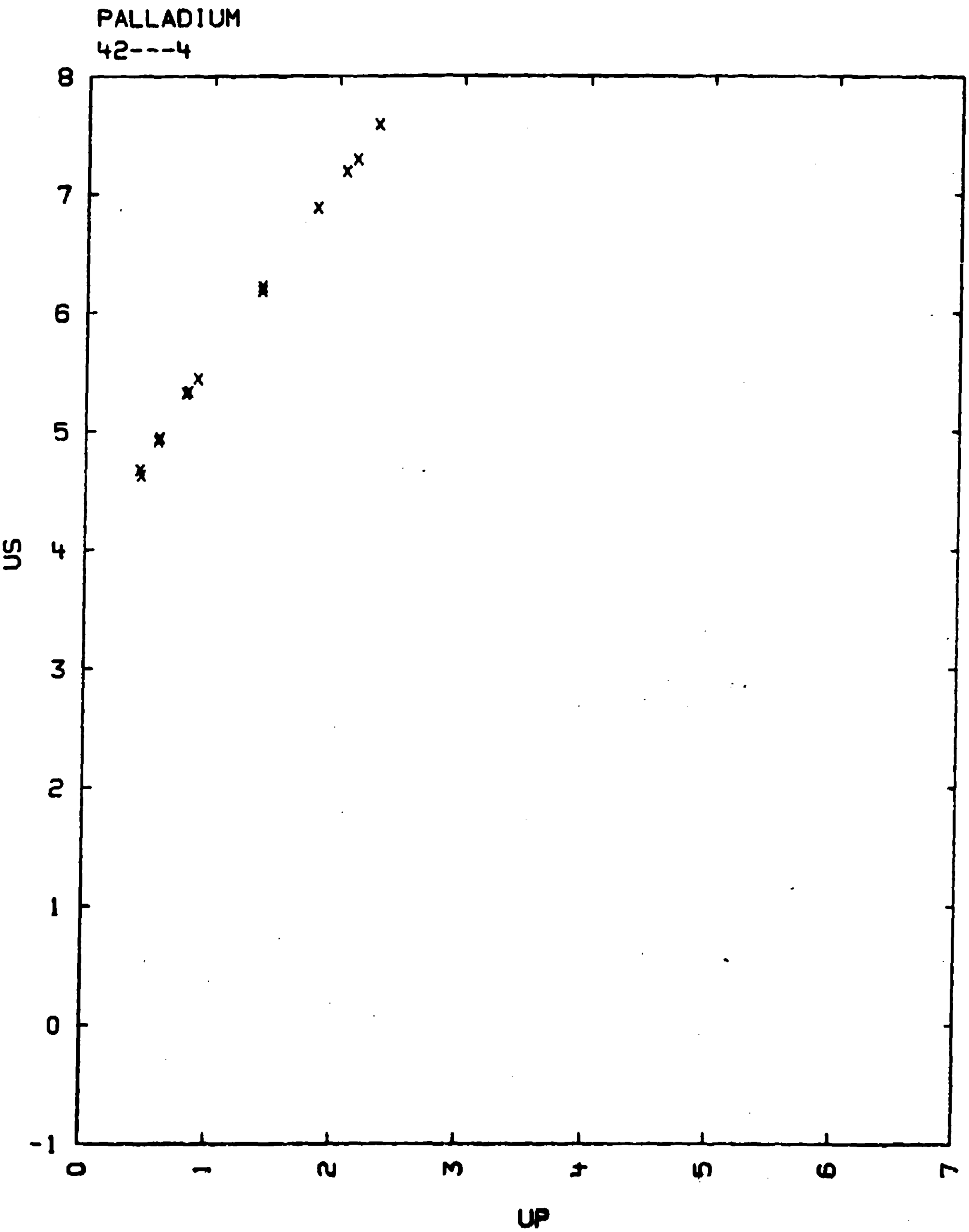
SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
12.000	4.67	0.44	247.	0.9058	CU	4.70
11.880	4.62	0.45	247.	0.9026	2024 AL	6.48
12.000	4.92	0.59	348.	0.8801	CU	4.95
11.950	4.94	0.60	354.	0.8785	2024 AL	6.86
12.020	5.31	0.80	511.	0.8493	2024 AL	7.35
12.000	5.32	0.82	523.	0.8459	CU	5.35
12.010	5.44	0.90	588.	0.8346	CU	5.47
12.000	6.18	1.40	1038.	0.7735	CU	6.29
12.000	6.21	1.40	1043.	0.7748	CU	6.30
12.000	6.21	1.40	1043.	0.7746	CU	6.31
12.000	6.88	1.84	1519.	0.7326	CU	7.03
12.000	7.19	2.07	1786.	0.7121	CU	7.39
12.000	7.29	2.15	1881.	0.7051	CU	7.52
12.000	7.58	2.32	2110.	0.6939	CU	7.80

US = 3.946 + 1.588*UP KM/SEC
SIG US = 0.041 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES, HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII
2) EXPERIMENTAL TECHNIQUE: B
DATA REDUCTION TECHNIQUE: B (STANDARD BASE PLATE AS SHOWN)
3) VOI IS THE 25 DEG. C. VALUE FROM WYCKOFF CRYSTAL STRUCTURES (JOHN WILEY AND SONS, N.Y., 1963) VOL. 1
4) V(DP/DE) = 2.260

TABLE I



43---1
RHODIUM

RH

V0 = 0.08045 CC/G
V01 = 0.08048 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

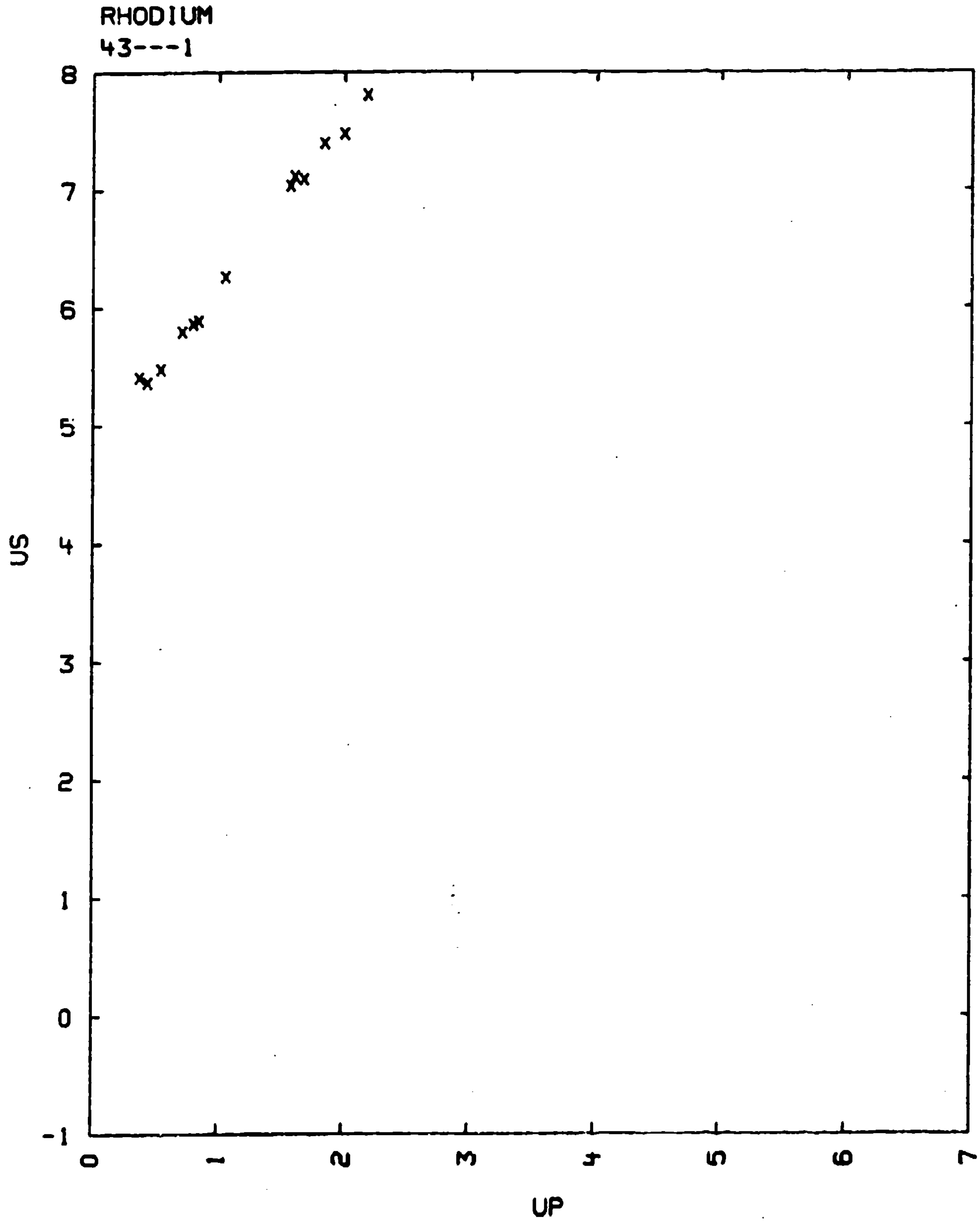
SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
12.420	5.40	0.37	248.	0.9315	2024 AL	5.68
12.430	5.38	0.43	286.	0.9198	CU	4.74
12.430	5.47	0.54	367.	0.9013	CU	4.94
12.420	5.79	0.71	511.	0.8774	2024 AL	6.03
12.430	5.86	0.80	583.	0.8635	CU	5.39
12.430	5.88	0.84	614.	0.8571	CU	5.46
12.430	6.26	1.06	825.	0.8307	CU	5.84
12.430	7.03	1.57	1372.	0.7767	CU	6.70
12.430	7.11	1.61	1423.	0.7738	CU	6.78
12.430	7.08	1.68	1478.	0.7627	CU	6.87
12.430	7.39	1.84	1690.	0.7510	CU	7.15
12.430	7.47	2.00	1857.	0.7323	CU	7.39
12.430	7.80	2.19	2132.	0.7192	CU	7.71

US = 4.807 + 1.376*UP KM/SEC
SIG US = 0.069 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES, HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII
2) EXPERIMENTAL TECHNIQUE: B
DATA REDUCTION TECHNIQUE: B (STANDARD BASEPLATE AS SHOWN)
3) V01 IS THE 25 DEG. C VALUE FROM WYCKOFF, CRYSTAL STRUCTURES (JOHN WILEY AND SONS, N.Y., 1963) VOL. I
4) V(DP/DE) = 1.88

TABLE I



45---1
PLATINUM

PT 99.8 PER CENT OR GREATER

V0 = 0.04679 CC/G.
V01 = 0.04651 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURE IN KILOBARS, AND DENSITY IN G/CC.

TABLE

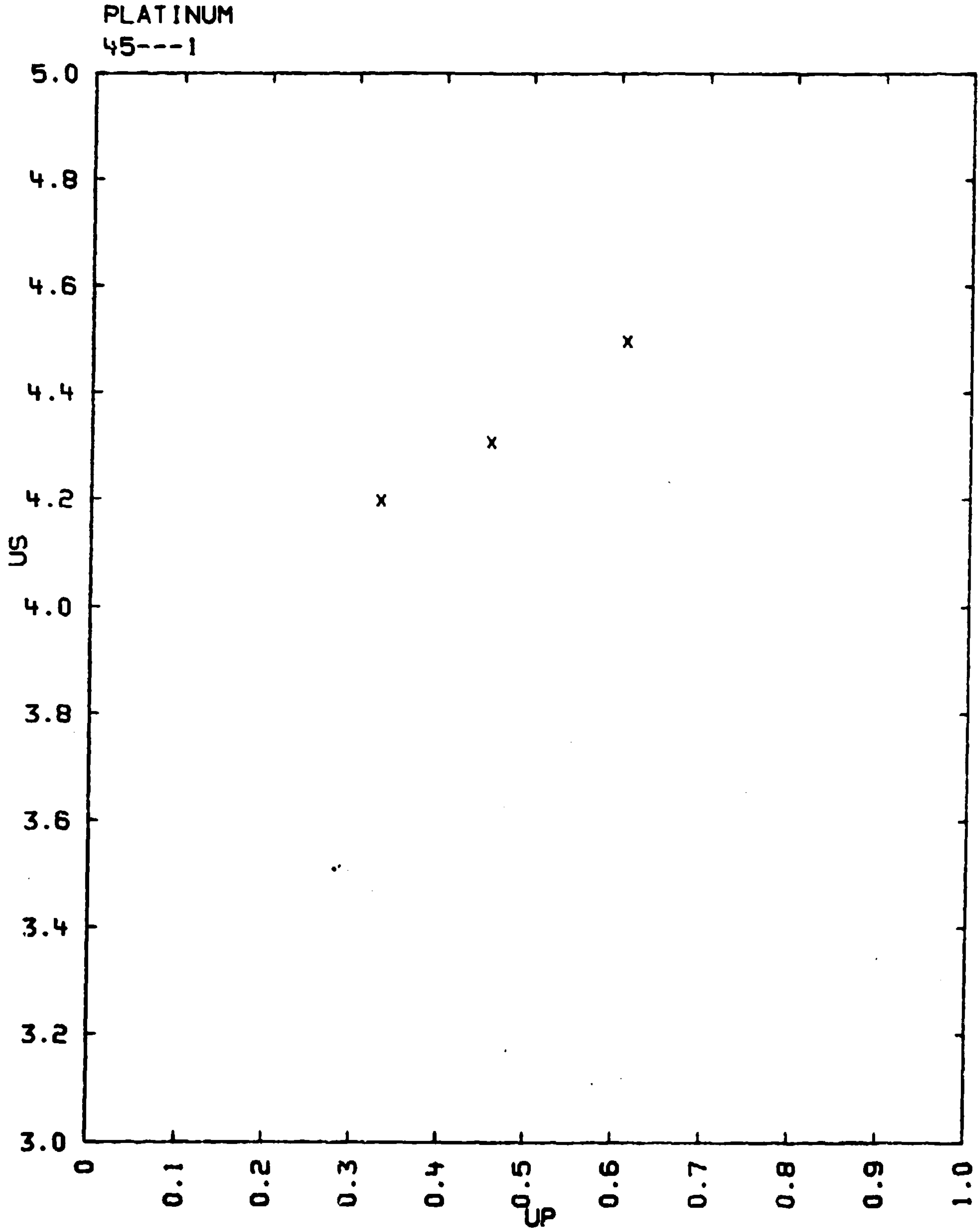
RHO0	US	UP	P	V/V0
21.37	4.199	0.329	295	0.9238
-	4.306	0.4550	416.5	0.8943
-	4.495	0.6102	586	0.8642

US = 3.841 + 1.059 UP KM/SEC SIGMA US = 0.5 PERCENT

COMMENTS:

1) SOURCE: WALSH, J. M., RICE, M. H., MCQUEEN, R. G. AND YARGER, F. L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 3 PER CENT IN COMPRESSION AT A GIVEN PRESSURE.
4) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS.

TABLE I


PLATINUM
45---1
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
US
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP

45---2
PLATINUM

PT 99.5 PERCENT OR GREATER

V0I= 0.0465 - CS = 1.79 - CB = 3.41 -
V0I = 0.0465 CCG. CS = 1.79 KM/SEC. CB = 3.41 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC,
PRESSURE IN KILOBARS AND DENSITIES IN G/CC.

TABLE

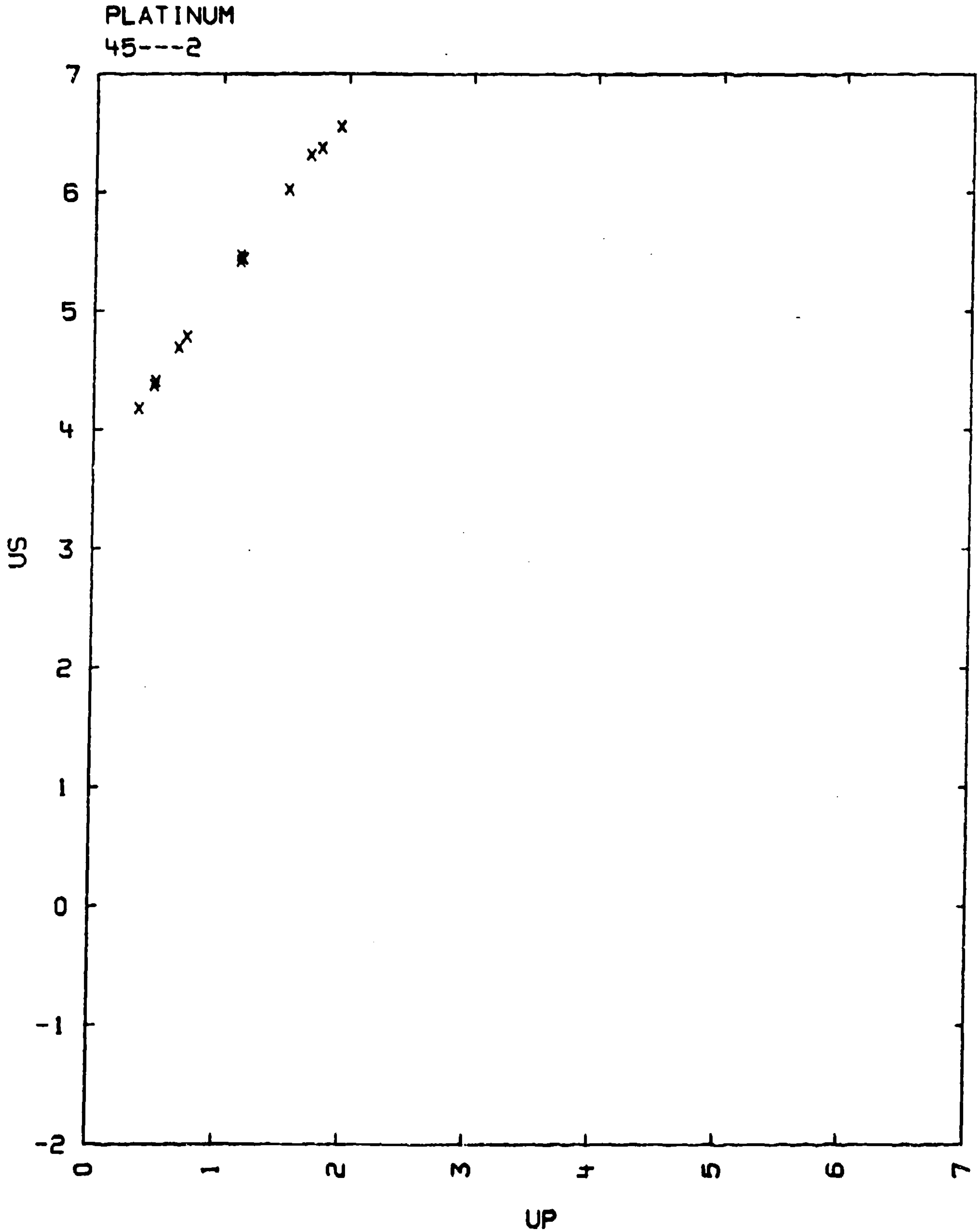
SAMPLE					STANDARD	
RHO0	US	UP	P	V/V0	RHO0	US
21.43	4.179	0.360	322.4	0.9139	8.932	4.764
-	4.365	0.483	451.8	0.8894	8.934	5.024
-	4.402	0.488	460.3	0.8891	-	5.040
-	4.682	0.675	677.3	0.8558	-	5.426
-	4.778	0.738	755.7	0.8455	-	5.556
-	5.420	1.150	1335.7	0.7878	-	6.387
-	5.465	1.152	1349.2	0.7892	-	6.400
-	5.442	1.180	1376.1	0.7832	-	6.443
-	6.014	1.526	1968.7	0.7463	-	7.133
-	6.316	1.700	2301.0	0.7308	-	7.482
-	6.367	1.787	2438.3	0.7193	-	7.632
-	6.548	1.937	2718.1	0.7042	-	7.910

US = 3.646 + 1.535 UP, SIG.US = 0.037 KM/SEC.

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
REPORT NO. GMX-6-566, PP. 51-62 (1964)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS COPPER
3) THE COPPER HUGONIOT IS REPRESENTED BY
US = 3.958 + 1.497 UP KM/SEC.
THE PARTIAL (DE/DP)V = 0.0562 CUBIC CM.
4) V0I WAS TAKEN FROM THE AMERICAN INSTITUTE OF PHYS. HANDBOOK (MCGRAW-HILL BOOK CO. N.Y., 1963) 2ND ED.

TABLE I



45---3
PLATINUM

PT 99.97 PER CENT OR GREATER

V0 =0.04664 CC/G
V01=0.04662 CC/G

THE TABLE LISTS DENSITY IN G/CC, VELOCITIES IN KM/SEC AND PRESSURE IN KBARS.

TABLE

RHO0	US	UP	P	V1/V0
21.46	6.67	2.04	2920.	0.694
21.44	6.73	2.14	3080.	0.682
21.45	6.96	2.26	3380.	0.675
21.44	6.91	2.27	3360.	0.671
21.44	7.23	2.38	3680.	0.671
21.45	7.13	2.48	3790.	0.652
21.45	7.17	2.49	3830.	0.653
21.43	7.39	2.52	4000.	0.658
21.46	7.45	2.60	4160.	0.651
21.44	7.49	2.66	4270.	0.645
21.44	7.64	2.70	4420.	0.647
21.47	7.58	2.73	4440.	0.639
21.44	7.62	2.74	4470.	0.641
21.44	7.83	2.88	4840.	0.631
21.44	7.77	2.90	4830.	0.627
21.45	7.90	2.92	4950.	0.630
21.44	8.25	3.04	5380.	0.632
21.45	8.21	3.08	5420.	0.625
21.45	8.25	3.18	5620.	0.615
21.44	8.18	3.18	5580.	0.611
21.44	8.37	3.19	5730.	0.619
21.44	8.46	3.25	5890.	0.616
21.45	8.59	3.28	6040.	0.618
21.45	8.59	3.37	6210.	0.608
21.45	8.87	3.46	6590.	0.609
21.42	8.60	3.48	6410.	0.596
21.45	8.75	3.49	6550.	0.601
21.42	8.91	3.49	6660.	0.608
21.42	8.88	3.49	6640.	0.607
21.44	8.67	3.52	6540.	0.594
21.43	8.87	3.59	6820.	0.596

US = 3.53 + 1.50*UP KM/SEC
SIG US= 0.092 KM/SEC

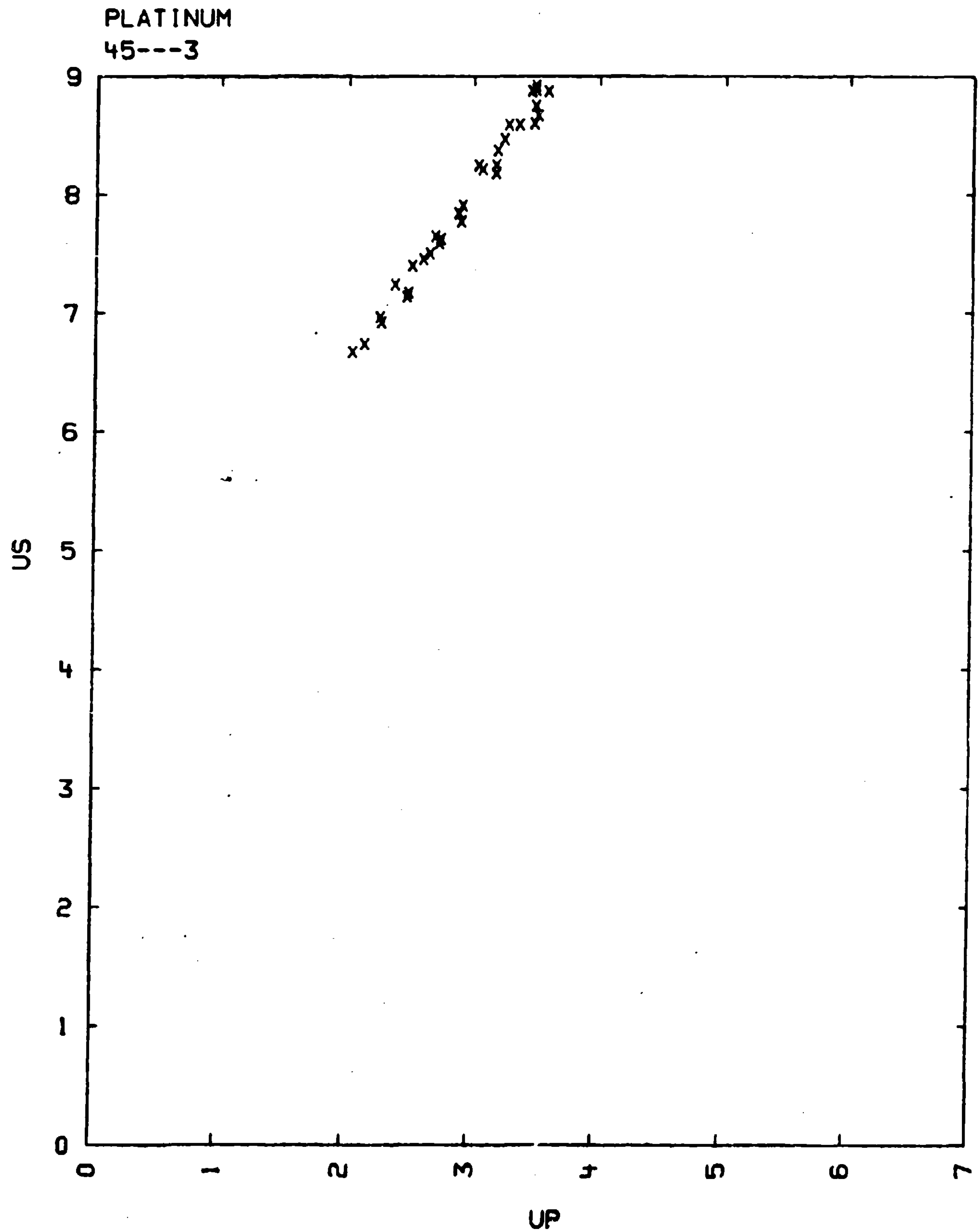
COMMENTS:

1) SOURCE: MORGAN,J.A.

HIGH TEMP HIGH PRES. VOL 6, P. 195 (1974)

2) EXPERIMENTAL TECHNIQUE A
   DATA REDUCTION TECHNIQUE A
3) SYMMETRIC IMPACT USING ACCELERATING RESERVOIR LIGHT GAS GUN
4) THE PRECISION IN UP=1/2 IMPACT VELOCITY IS 0.2 PERCENT AND IN US
   IS 1. PERCENT
5) THE SAMPLES WERE CAST ROLLED AND PEENED TO THE LISTED DENSITY

TABLE I



45---4
PLATINUM

PT

VO = 0.04666 CC/G   CL = 4.08 KM/SEC   CO = 3.51 KM/SEC
VOI= 0.04660 -   CS = 1.79 -   CB = 3.64 -

THE TABLE LISTS VELOCITIES IN KM/SEC, PRESSURE IN KBARS AND DENSITY IN G/CC. STANDARD MATERIAL DESCRIBES THE IMPACTOR

TABLE

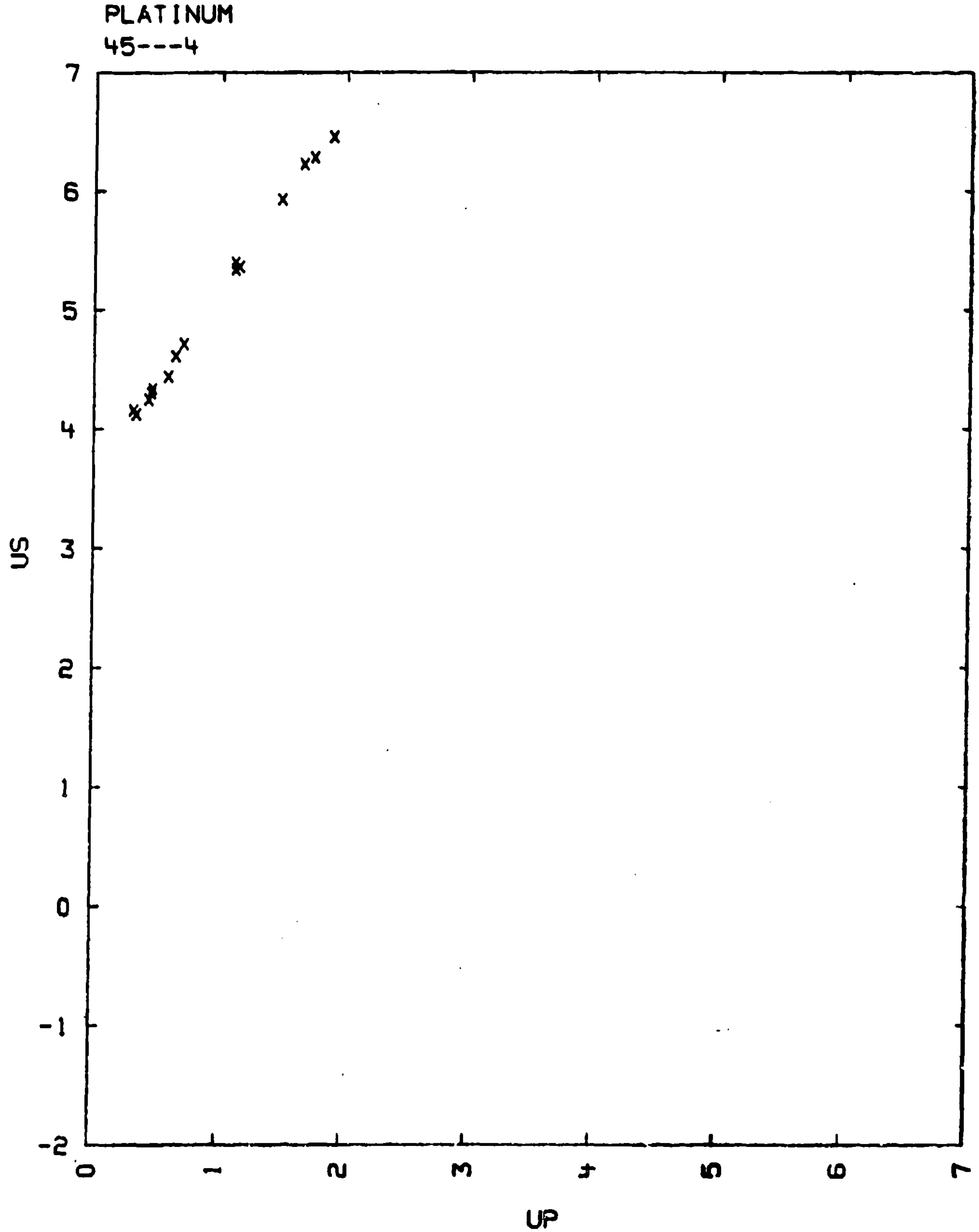
----SAMPLE----					----STANDARD----	
RHOO	US	UP	P	V/VO	MATERIAL	
21.370	4.15	0.32	284.	0.9229	2024 AL	6.48
21.430	4.12	0.34	300.	0.9175	CU	4.70
21.370	4.25	0.44	400.	0.8965	2024 AL	6.86
21.430	4.30	0.46	424.	0.8930	CU	4.95
21.430	4.34	0.47	437.	0.8917	CU	4.97
21.370	4.44	0.60	569.	0.8649	2024 AL	7.32
21.430	4.61	0.65	642.	0.8590	CU	5.35
21.430	4.71	0.71	717.	0.8493	CU	5.48
21.430	5.34	1.12	1282.	0.7903	CU	6.29
21.430	5.39	1.12	1294.	0.7922	CU	6.31
21.430	5.36	1.15	1321.	0.7854	CU	6.35
21.430	5.93	1.49	1893.	0.7487	CU	7.03
21.430	6.22	1.66	2213.	0.7331	CU	7.37
21.430	6.28	1.75	2355.	0.7213	CU	7.52
21.430	6.45	1.90	2626.	0.7054	CU	7.80

US = 3.598 + 1.544*UP
SIGMA US = 0.046 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES, HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII
2) EXPERIMENTAL TECHNIQUE: B
DATA REDUCTION TECHNIQUE: B (STANDARD BASEPLATE AS SHOWN)
3) VOI IS THE 25 DEG. C VALUE FROM WYCKOFF, CRYSTAL STRUCTURES (JOHN WILEY AND SONS, N.Y., 1963) VOL. 1
4) V(DP/DE)=2.4

TABLE I



48---1
IRIDIUM

IR

V0 = 0.4452 CC/G
V0I= 0.4434 CC/G

THE TABLE LISTS VELOCITIES IN KM/SEC, PRESSURE IN KBARS AND DENSITY IN G/CC. STANDARD MATERIAL DESCRIBES THE IMPACTOR

TABLE

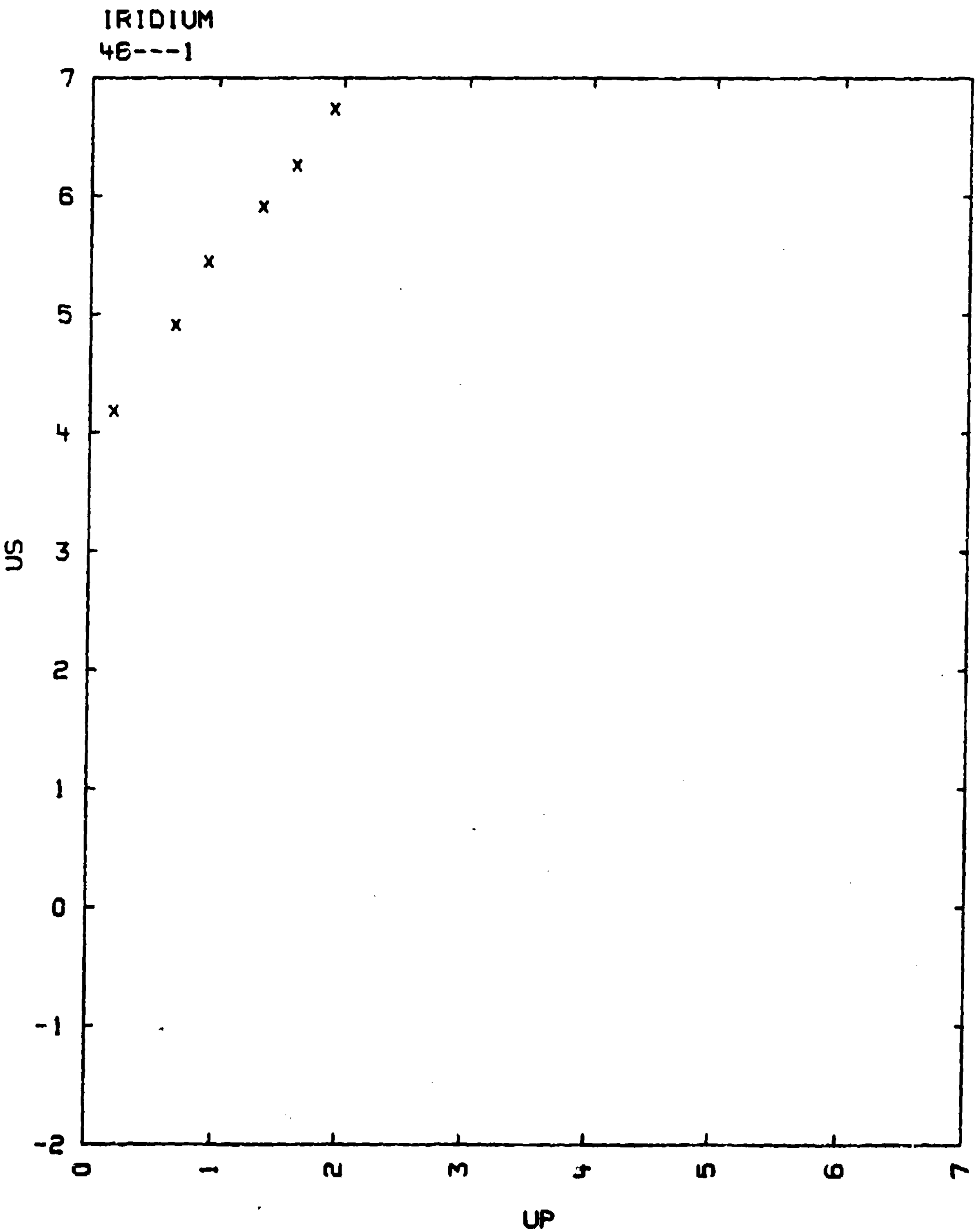
SAMPLE					STANDARD	
RHO0	US	UP	P	V/V0	MATERIAL	
22.420	4.18	0.19	178.	0.9545	CU	4.41
22.500	4.90	0.67	739.	0.8633	CU	5.48
22.420	5.44	0.93	1134.	0.8290	CU	6.04
22.500	5.90	1.36	1805.	0.7695	CU	6.87
22.500	6.26	1.63	2296.	0.7396	CU	7.39
22.500	6.73	1.93	2923.	0.7132	CU	7.99

US = 3.916 + 1.457*UP
SIGMA US = 0.081 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES, HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII
2) EXPERIMENTAL TECHNIQUE: B
DATA REDUCTION TECHNIQUE: B (STANDARD BASEPLATE AS SHOWN)
3) V0I IS THE 25 DEG. C VALUE FROM WYCKOFF, CRYSTAL STRUCTURES (JOHN WILEY AND SONS, N.Y., 1963) VOL. 1
4) V(DP/DE)=1.97

TABLE I



50---1
RHENIUM

RE

V0 = 0.04784 CC/G CL = 5.33 KM/SEC C0 = 4.16 KM/SEC
V01 = 0.04759 CC/G CS = 2.89 KM/SEC

IN THE TABLES BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBAR AND DENSITY IN G/CC.

TABLE I

SAMPLE					STANDARD	
RHO0	US	UP	P	V/V0	MATERIAL	US(ST)
20.990	4.69	0.33	325.	0.9296	CU	4.72
20.960	4.74	0.43	427.	0.9093	CU	4.94
20.980	5.04	0.66	698.	0.8690	CU	5.42
20.990	5.19	0.69	752.	0.8671	CU	5.49
20.990	5.51	0.96	1110.	0.8258	CU	6.04
20.990	5.71	1.13	1354.	0.8021	CU	6.36

US = 4.184 + 1.367*UP KM/SEC
SIGMA US = 0.050 KM/SEC

V0 = 0.04871 CC/G C0 = 4.10 KM/SEC

TABLE II

SAMPLE					STANDARD	
RHO0	US	UP	P	V/V0	MATERIAL	US(ST)
20.530	4.15	0.21	179.	0.9484	CU	4.41
20.530	4.08	0.37	310.	0.9093	CU	4.74
20.530	4.29	0.48	423.	0.8881	CU	4.96
20.530	4.77	0.68	666.	0.8574	CU	5.39
20.530	4.79	0.72	708.	0.8497	CU	5.46
20.530	5.74	1.35	1591.	0.7648	CU	6.70
20.530	5.87	1.38	1663.	0.7649	CU	6.78
20.530	5.81	1.44	1718.	0.7522	CU	6.87
20.530	6.04	1.58	1959.	0.7384	CU	7.15
20.530	6.15	1.72	2172.	0.7203	CU	7.39
20.530	6.69	2.03	2788.	0.6966	CU	7.99

US = 3.653 + 1.596*UP - 0.053*UP**2 KM/SEC
SIG US = 0.11 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES, HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII

2) EXPERIMENTAL TECHNIQUE: B
DATA REDUCTION TECHNIQUE: B (STANDARD BASE PLATE AS SHOWN)

3) V0I IS THE 25 DEG. C. VALUE FROM WYCKOFF, CRYSTAL STRUCTURES (JOHN WILEY AND SONS, N.Y., 1963; VOL. 1

4) V(DP/DE) = 2.440

TABLE I

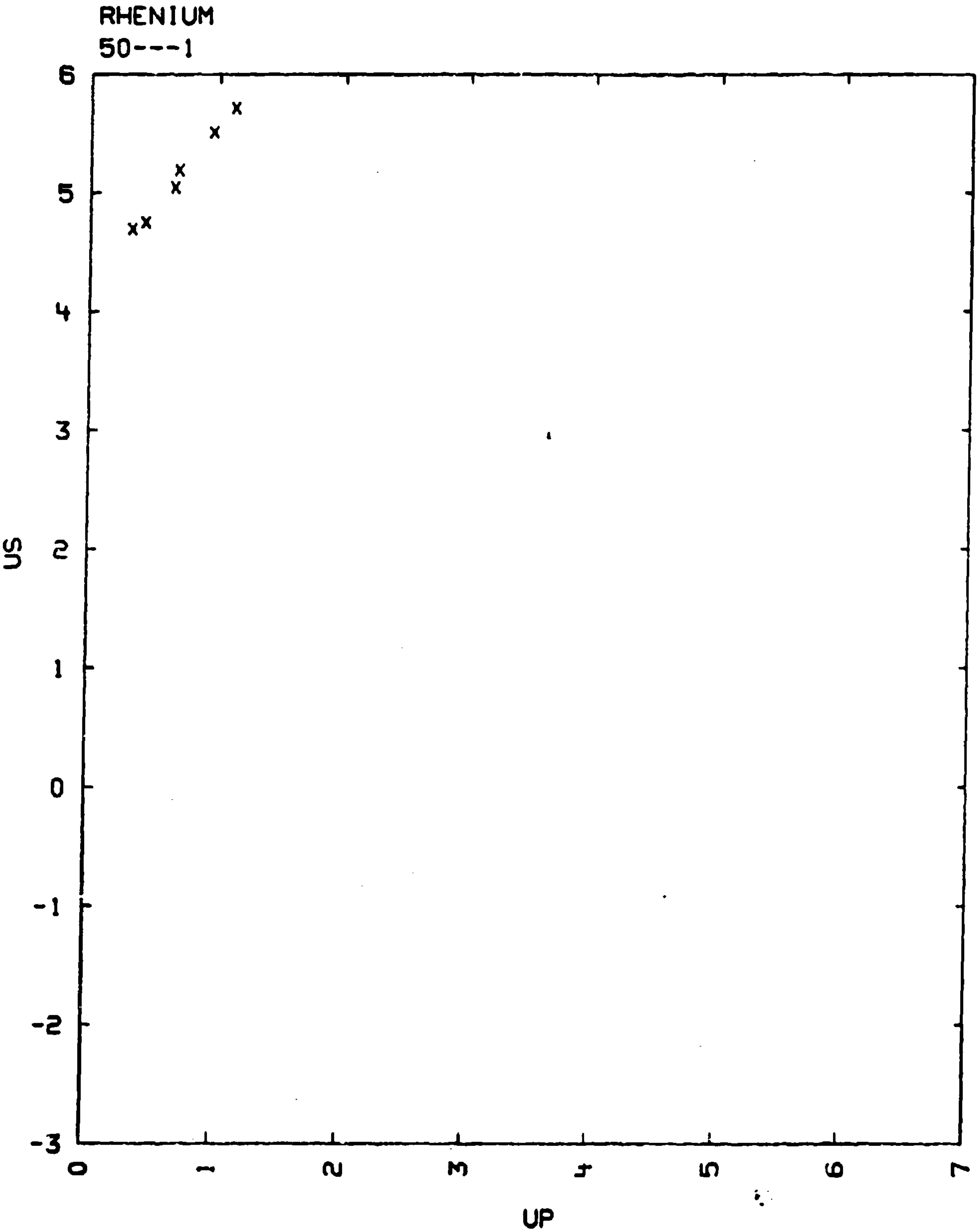
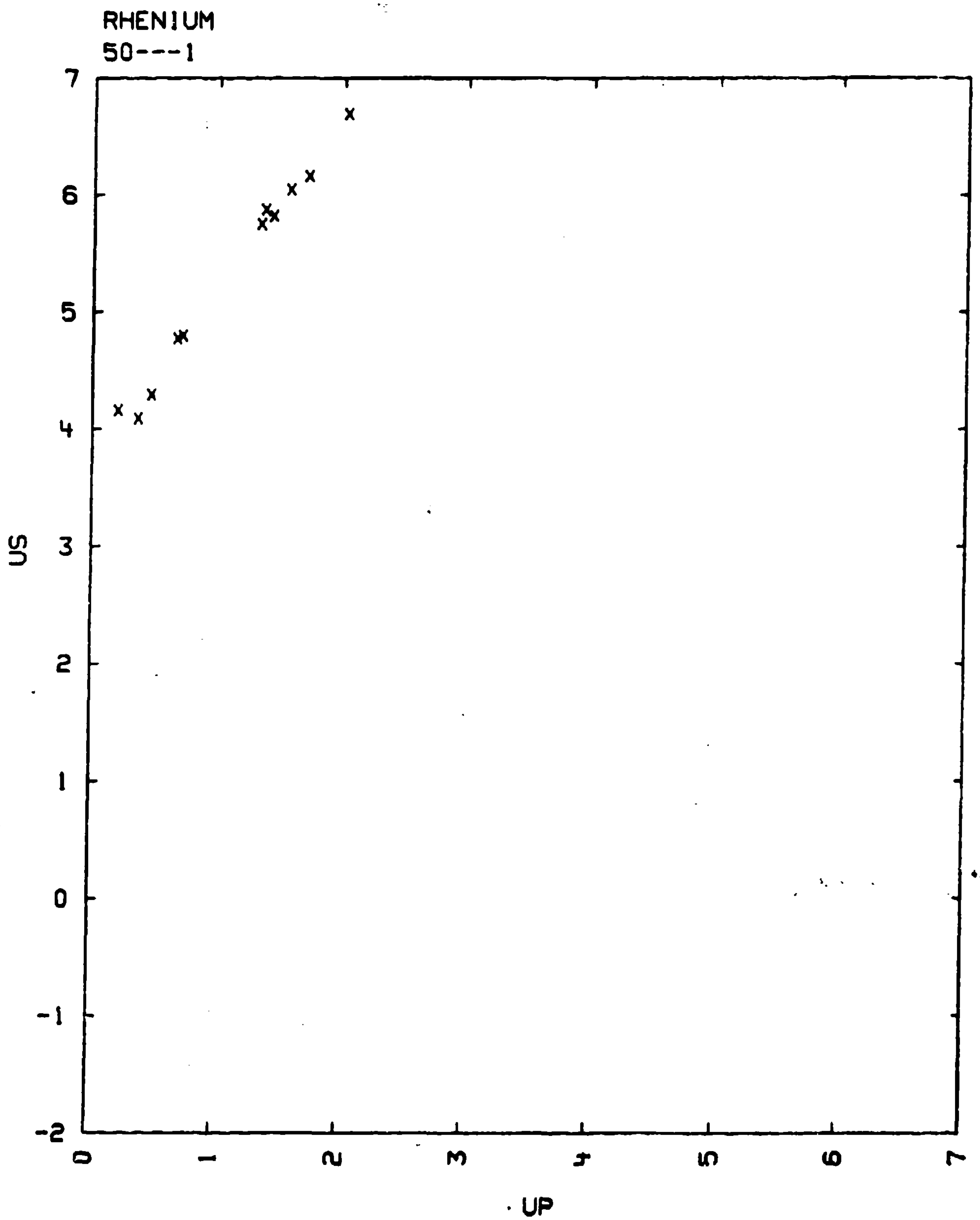


TABLE II



51---1
CHROMIUM

CR 99.8 PER CENT OR GREATER

V0 = 0.1403 CC/G.
V01 = 0.1385 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC. PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

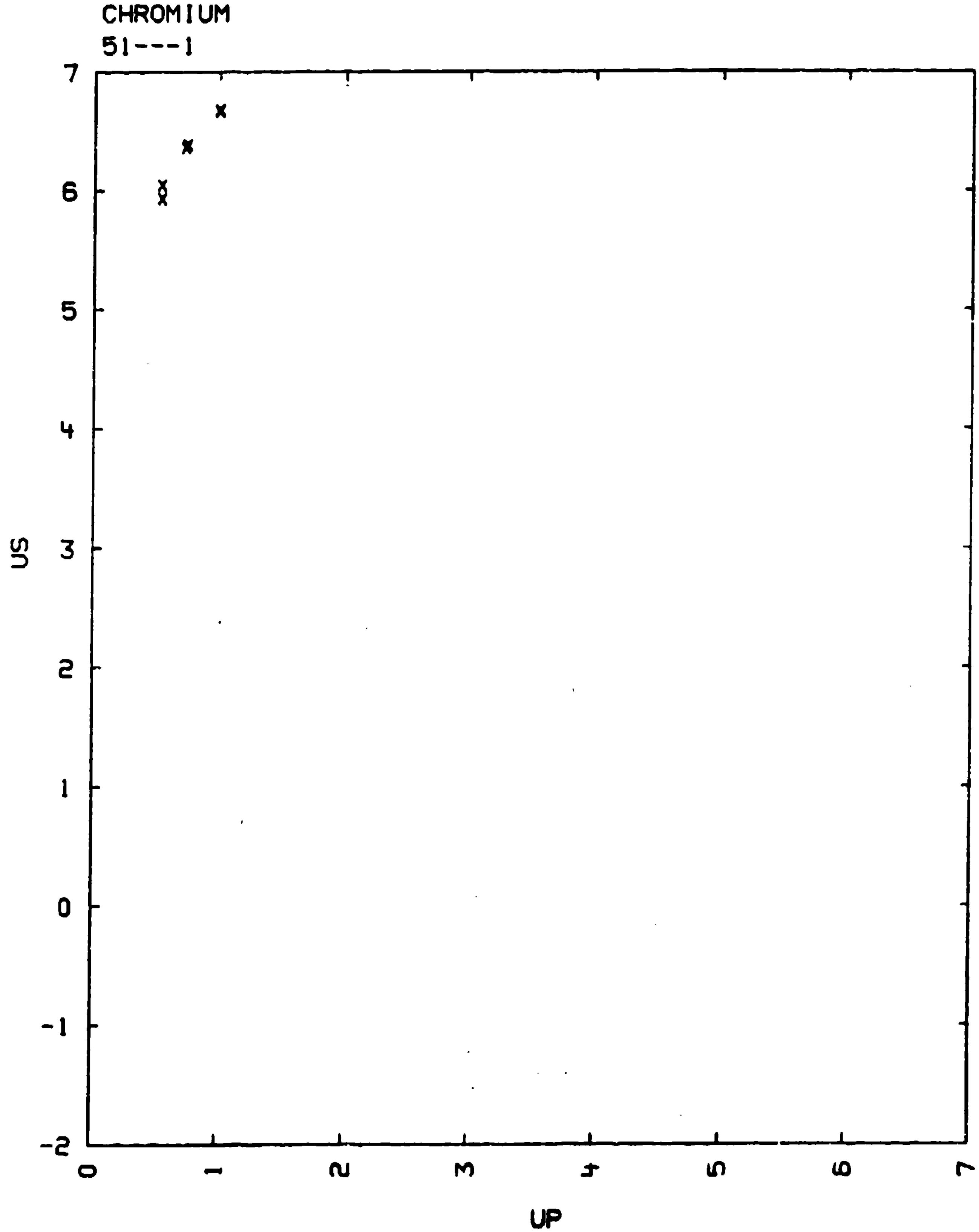
RHO0	US	UP	P	V/V0
7.13	6.043	0.5448	234.5	0.9098
-	5.923	0.5395	233	0.9089
-	6.381	0.7436	338	0.8835
-	6.370	0.7449	338	0.8831
-	6.355	0.7407	336	0.8834
-	6.357	0.7403	336	0.8835
-	6.660	1.007	478	0.8488
-	6.674	1.008	479	0.8490

US = 5.249 + 1.445 UP KM/SEC   SIGMA US = 1.0 PERCENT

COMMENTS:

1) SOURCE: WALSH, J. M., RICE, M. H., MCQUEEN, R. G. AND YARGER, F. L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS
4) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 1 PER CENT IN COMPRESSION AT A GIVEN PRESSURE.

TABLE I



51---2
CHROMIUM

CR

VO = 0.141 CC/G.   CO = 5.15 KM/SEC.
VOI = 0.139 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC.,
PRESSURES IN KILOBARS AND DENSITY IN G/CC.

TABLE

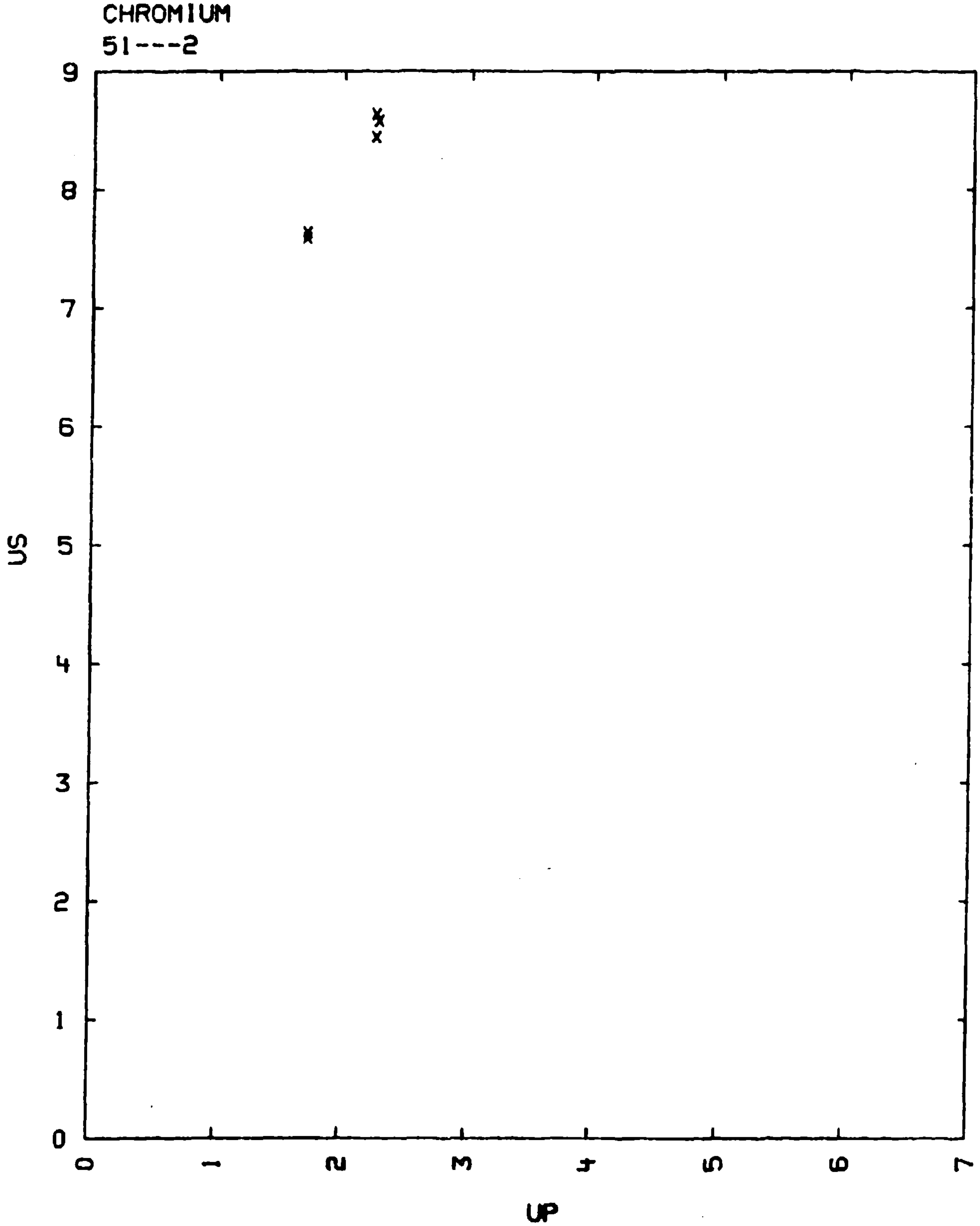
RHOO	US	UP	P	V/VO	PRESSURE IN BRASS STANDARD
7.10	7.63	1.71	924	0.777	914
-	7.59	1.71	922	0.775	914
-	8.44	2.25	1347	0.734	1363
-	8.57	2.27	1382	0.735	1369
-	8.63	2.25	1379	0.739	1358

US = 5.217 + 1.465 UP KM/SEC.   SIGMA US = 0.63 PERCENT

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
J. APPL. PHYS., VOL. 31, P. 1253 (1960)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS BRASS
3) FOR THE BRASS STANDARD DATA SEE MATERIAL 36-33
4) VOI WAS TAKEN FROM THE AMERICAN INSTITUTE OF PHYS. HANDBOOK (MCGRAW-HILL BOOK CO. N.Y., 1963) 2ND ED.

TABLE I



51---3
CHROMIUM

CR

VO = 0.1402 - 0.1408 CC/G	CL = 6.60 KM/SEC	CO = 4.32 KM/SEC
VOI = 0.1389 -	CS = 4.32 -	CB = 5.15 -

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

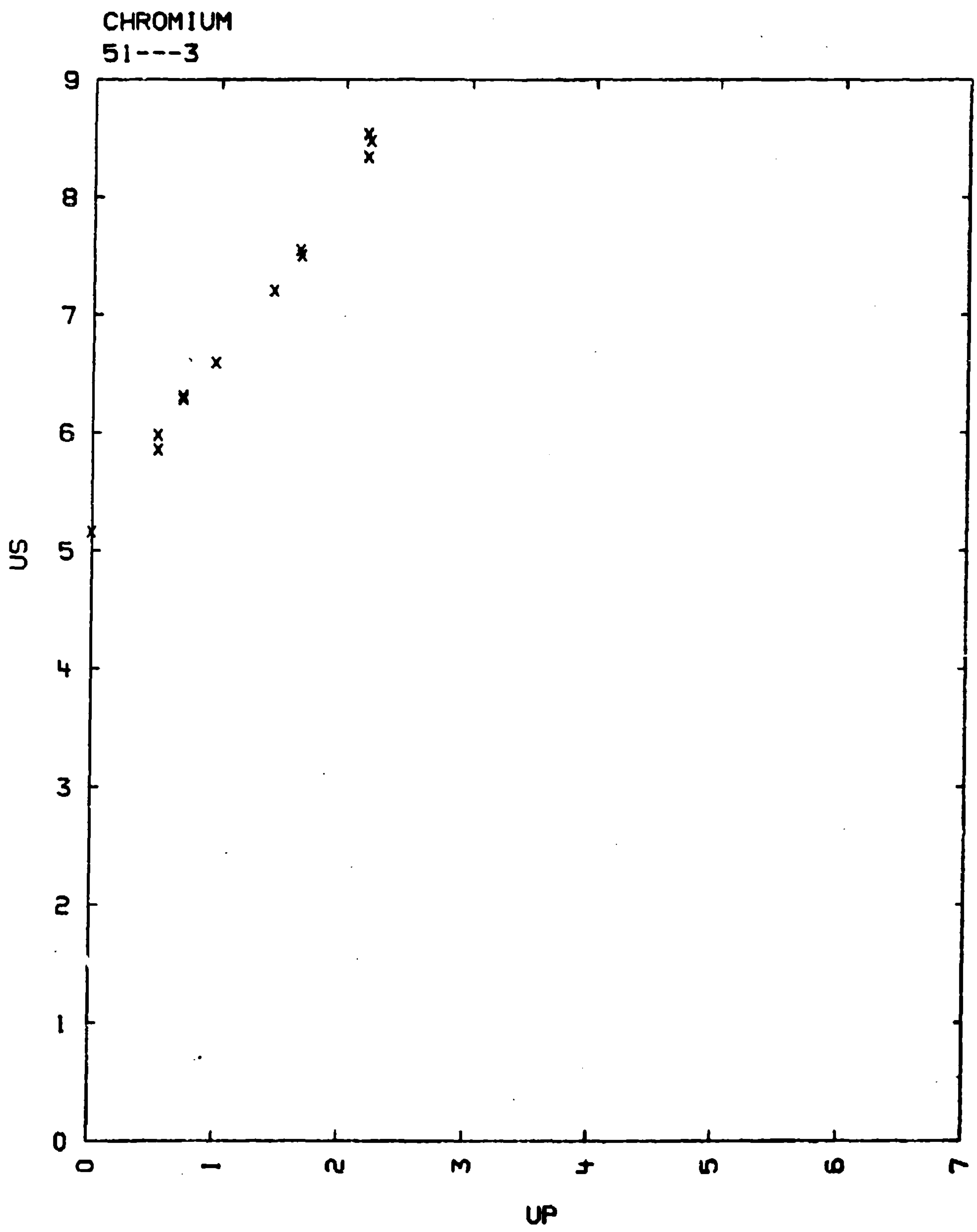
SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
7.100	5.15	0.	0.	1.0000	CO	0.
7.130	5.85	0.52	217.	0.9111	2024 AL	6.43
7.130	5.97	0.52	221.	0.9129	2024 AL	6.46
7.130	6.28	0.72	322.	0.8854	2024 AL	6.85
7.130	6.28	0.72	322.	0.8854	2024 AL	6.85
7.130	6.30	0.72	323.	0.8857	2024 AL	6.86
7.130	6.29	0.72	323.	0.8855	2024 AL	6.86
7.130	6.58	0.98	460.	0.8511	2024 AL	7.36
7.130	6.59	0.98	460.	0.8513	2024 AL	7.36
7.123	7.20	1.44	739.	0.8000	CU	6.04
7.100	7.54	1.65	883.	0.7812	BRASS	6.17
7.100	7.50	1.66	884.	0.7787	BRASS	6.18
7.100	8.34	2.19	1297.	0.7374	BRASS	6.93
7.100	8.53	2.19	1326.	0.7433	BRASS	6.96
7.100	8.47	2.21	1329.	0.7391	BRASS	6.97

US = 5.173 + 1.473*UP KM/SEC
SIGMA US = 0.074 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.N., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES.
HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII
2) EXPERIMENTAL TECHNIQUE: B
DATA REDUCTION TECHNIQUE: B
3) VOI FROM WYCKOFF CRYSTAL STRUCTURES (JOHN WILEY AND SONS, N.Y., 1963) VOL. 1
4) V(DP/DE) = 1.19
5) HUGONIOT ELASTIC LIMIT 18. KBAR

TABLE I



52---0
MOLYBDENUM SUMMARY

MO

VO = 0.0980 - 0.0987 CC/G
VO1= 0.09785 CC/G   CB = 5.19 KM/SEC

THE TABLE LISTS THE HUGONIOT POINTS CALCULATED FROM THE FIT GIVEN BELOW. UNITS ARE: G/CC, KM/SEC, KBAR AND KBAR.CC/G FOR THE ENERGY DIFFERENCE.

TABLE

RHOO	US	UP	P	V/VO	E-EO
10.20	5.645	.4	230.	0.9291	0.8
	6.021	.7	430	0.8837	2.45
	6.398	1.	652	0.844	5.0
	7.025	1.5	1075	0.786	11.25
	7.653	2.	1561	0.739	20.0
	8.908	3.	2726	0.663	45.0
	10.163	4.	4146	0.606	80.0
	10.790	4.5	4953	0.583	101.

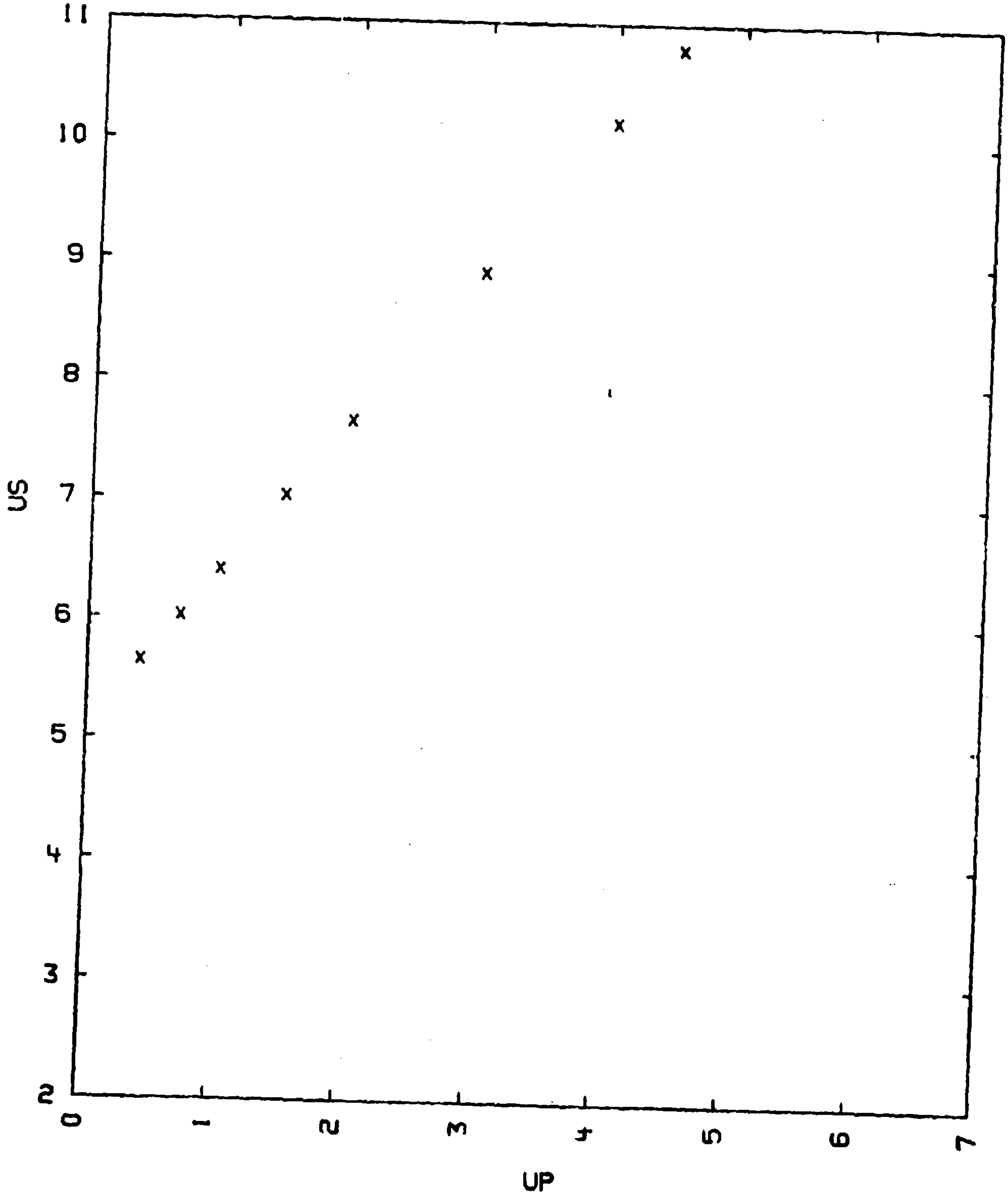
US = 5.143 + 1.255 UP, SIG.US = 0.06 KM/SEC
FOR UP BETWEEN .4 AND 4.3 KM/SEC.

COMMENTS:

1) SOURCE: COMPILER
1A) DATA FROM 52---1,2 AND 3 WERE USED TO MAKE THE FIT
2) VO1 WAS OBTAINED FROM THE CUBIC LATTICE CONSTANT A = 3.1473 ANGSTROM AT 25 DEG. C. LISTED BY: WYCKOFF, CRYSTAL STRUCTURES, VOL 1,(INTER-SCIENCE PUBL., N. Y. 1963) 2ND. ED.
3) CB WAS TAKEN FROM 52---2.

TABLE I

MOLYBDENUM SUMMARY
52---0



52---1
MOLYBDENUM

MO 99.8 PER CENT OR GREATER

VO = 0.0980 CC/G.
VOI = 0.0980 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC. PRESSURE IN KILOBARS, AND DENSITY IN G/CC.

TABLE

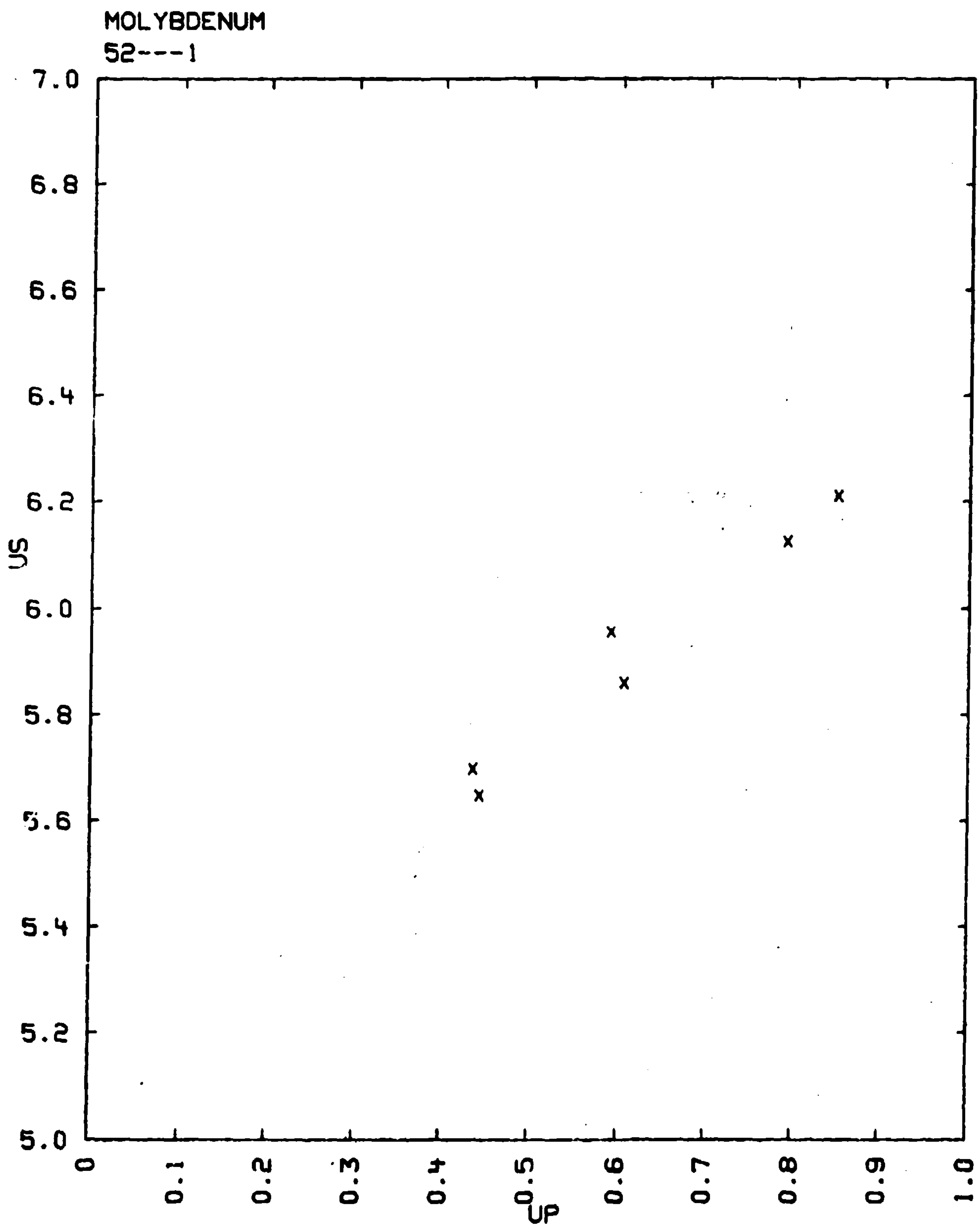
RHOO	US	UFS	UP	P	V/VO
10.20	5.699	0.874	0.437	254.0	0.9233
-	5.647	0.888	0.444	255.2	0.9214
-	5.955	1.176	0.591	359.0	0.9008
-	5.861	1.200	0.606	362.3	0.8966
-	6.210	1.724	0.850	538.4	0.8631
-	6.124	1.636	0.792	494.7	0.8707

US = 5.120 + 1.285 UP KM/SEC   SIGMA US = 0.08 PERCENT

COMMENTS:

1) SOURCE: WALSH, J. M., RICE, M. H., MCQUEEN, R. G. AND YARGER, F. L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 1 PER CENT IN COMPRESSION AT A GIVEN PRESSURE.
4) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS.

TABLE I


MOLYBDENUM
52---1
7.0
6.8
6.6
6.4
6.2
6.0
5.8
5.6
5.4
5.2
5.0
US
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP

52---2
MOLYBDENUM

MO

V0 = 0.09804 CC/G.
V01 = 0.09804 CC/G. CB = 5.19 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC,
PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

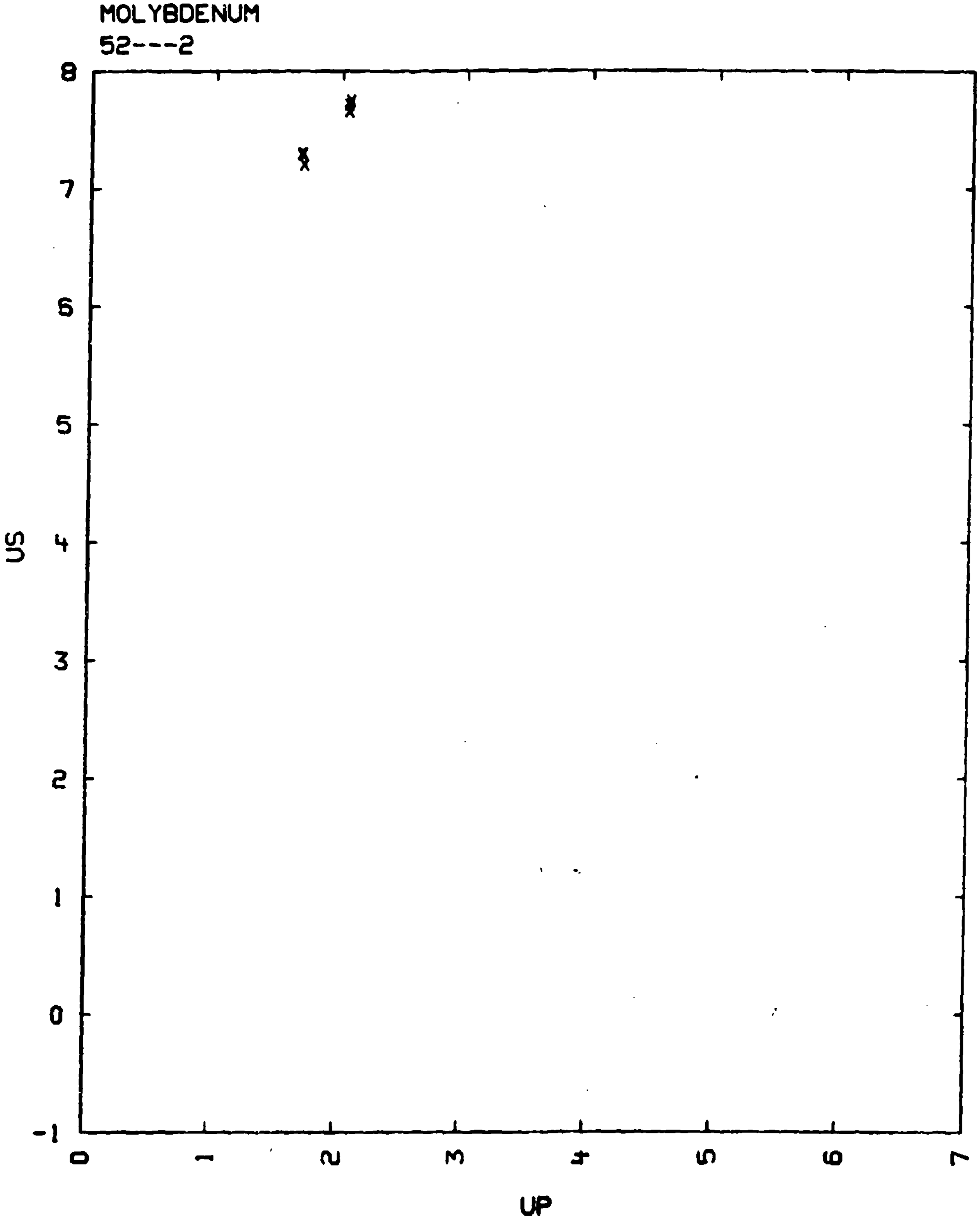
RHO0	US	UP	P	V/V0	PRESSURE IN BRASS STANDARD
10.20	7.29	1.69	1256	0.768	1064
-	7.20	1.70	1245	0.764	1064
-	7.29	1.68	1250	0.770	1058
-	7.65	2.06	1604	0.731	1380
-	7.71	2.06	1618	0.733	1387
-	7.75	2.07	1633	0.733	1399

US = 5.157 + 1.238 UP KM/SEC. SIGMA US = 0.41 PERCENT

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
J. APPL. PHYS., VOL. 31, P. 1253 (1960)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS BRASS
3) FOR THE BRASS STANDARD DATA SEE MATERIAL 36-33
4) V01 WAS TAKEN FROM THE AMERICAN INSTITUTE OF PHYS. HANDBOOK (MCGRAW-
HILL BOOK CO. N.Y., 1963) 2ND ED.

TABLE I



52---3
MOLYBDENUM

MO

VO = 0.0980 CC/G
VOI = 0.09804 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC. ST DESIGNATES THE STANDARD MATERIAL USED AS STRIKER PLATE. U(ST) IS THE VELOCITY BEFORE IMPACT.

TABLE

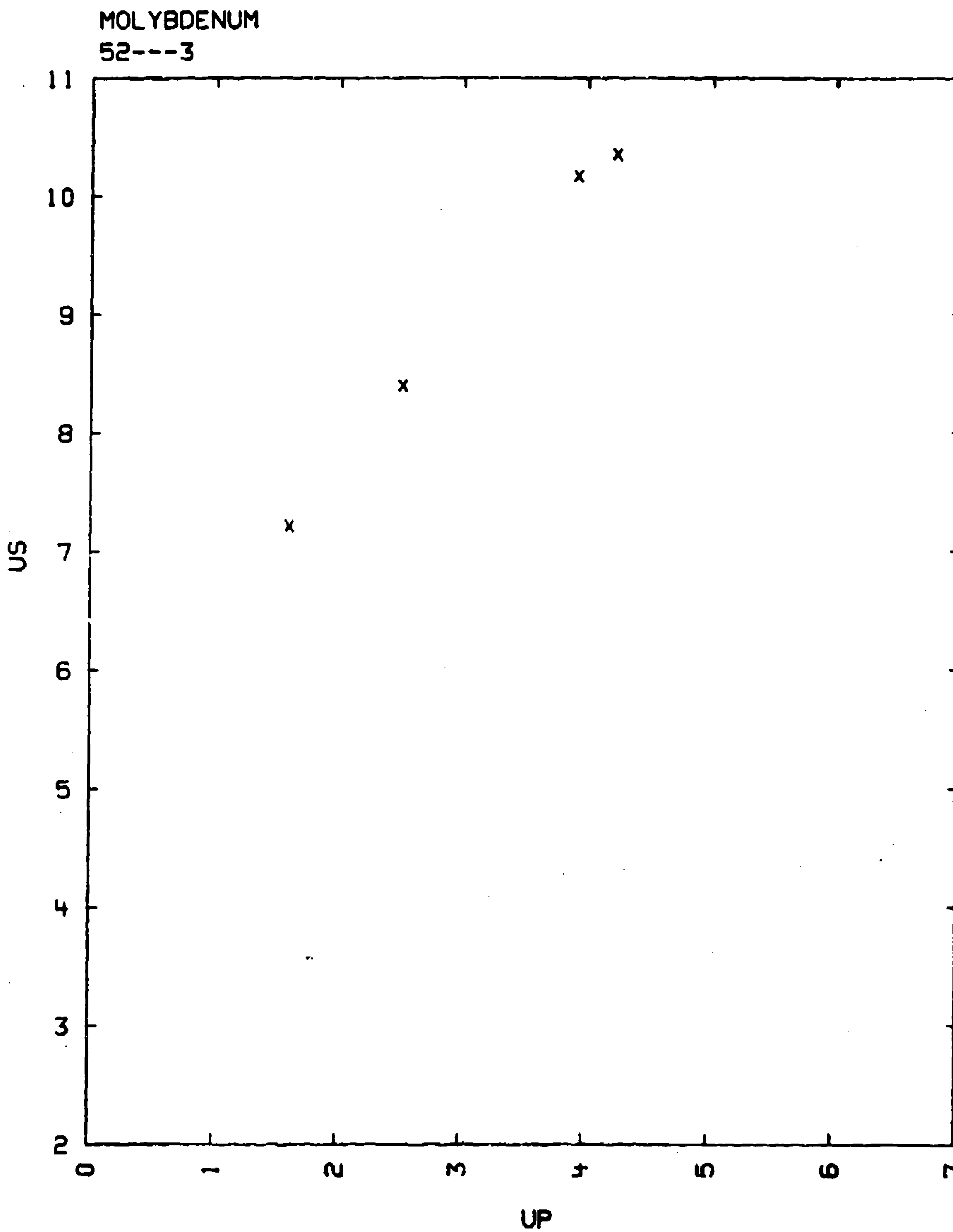
RHOO	US	UP	P	V/VO	ST	U(ST)
10.2	7.21	1.60	1176	0.7782	AL	5.600
-	8.39	2.52	2154	0.6998	FE	5.600
-	10.16	3.92	4060	0.5903	FE	8.640
-	10.35	4.24	4477	0.6143	FE	9.100

US = 5.30 + 1.21 UP KM/SEC. FOR UP BETWEEN 1.60 TO 4.24 KM/SEC.
SIGMA US = 0.10 KM/SEC.

COMMENTS:

1) SOURCE: KRUPNIKOV, K. K., BAKANOVA, A. A., BRAZNIK, M. I. AND TRUNIN, R. F.
SOVIET PHYS.-JETP, VOL. 8, P. 205 (1963)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE B
3) THE SAMPLES WERE POSITIONED ON PLATES OF AL OR FE AS INDICATED IN COLUMN 6 OF THE TABLE.
4) THE SPECIMENS WERE 3 TO 4 MM THICK AND 10 TO 15 MM IN DIAMETER.
5) THE PRESSURES WERE PRODUCED BY AN EXPLOSIVELY ACCELERATED ALUMINUM OR STEEL PLATE AS INDICATED IN COLUMN 6.
6) VOI WAS OBTAINED FROM THE AMERICAN INSTITUTE OF PHYSICS HANDBOOK (MCGRAW-HILL BOOK CO. N.Y., 1963) 2ND ED.
7) ALSO LISTED ARE: RHOO AT 0 DEG. K. = 10.24 G/CC
ELECTRONIC HEAT CAPACITY COEFFICIENT
225 ERG/G DEG**2
GRUNEISEN CONSTANT = 1.56

TABLE I



52---4
MOLYBDENUM

MO

V0 = 0.0987 CC/G
V01 = 0.09752 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN KM/SEC, AND PRESSURE IN KILOBARS.

TABLE

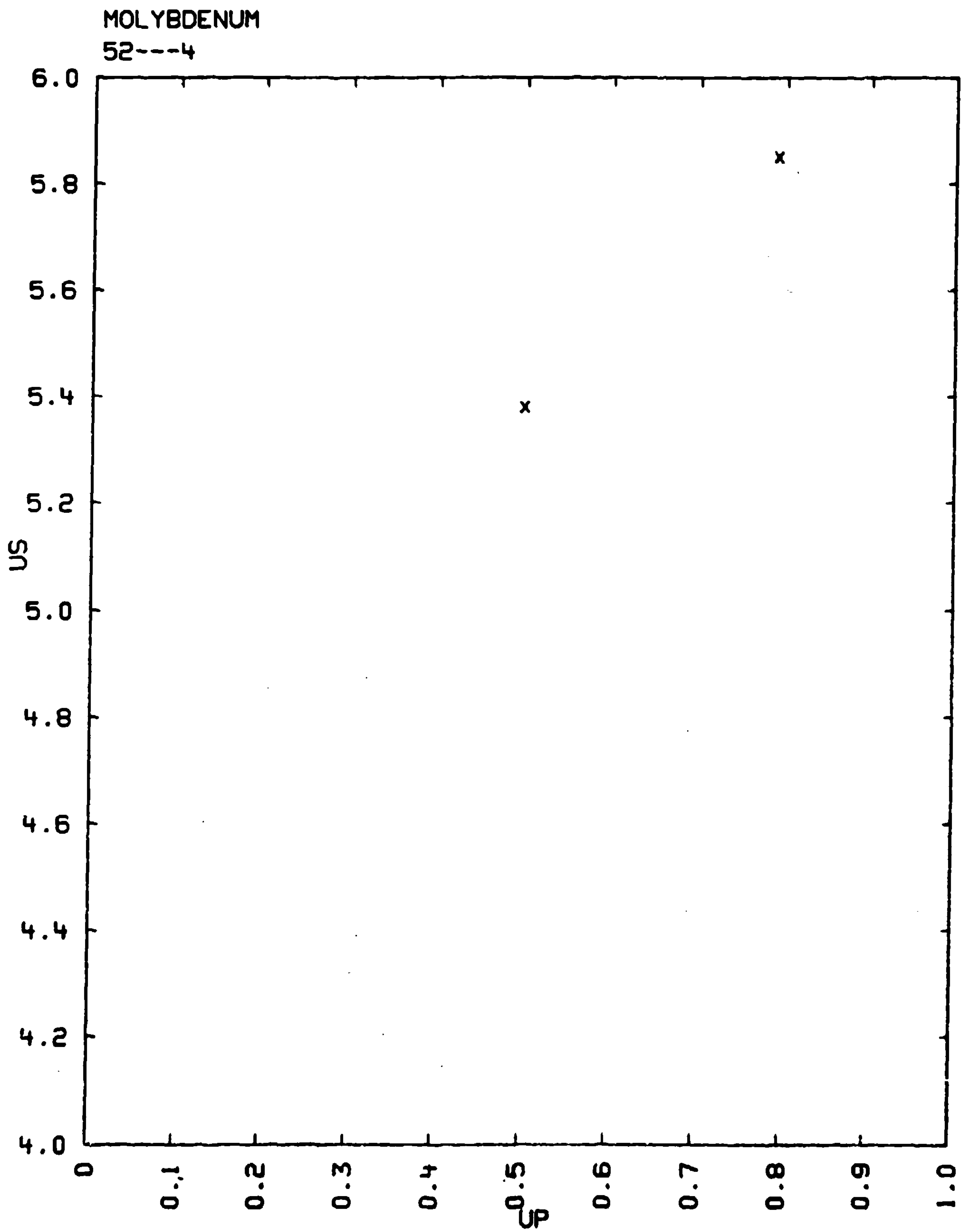
SAMPLE						BASE PLATE
RHO0	US	UFS	UP	P	V/V0	PRESSURE
10.13	5.85		0.79	469	0.865	288
10.13	5.39	0.935	0.50	270	0.908	166

US =

COMMENTS:

1) SOURCE: COMPILER
L.R.L. EQUATION OF STATE FILE
LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIFORNIA.
2) EXPERIMENTAL TECHNIQUE B. (ALUMINUM STANDARD BASE PLATE)
DATA REDUCTION TECHNIQUE B.
3) THE VALUE OF V01 WAS OBTAINED FROM A LATTICE CONSTANT OF 3.14737 A
A.C.A MONOGRAPH NO. 5, CRYSTAL DATA DETERMINATIVE TABLES
(AMERICAN CRYSTALLOGRAPHIC ASSOCIATION, 1963) 2ND EDITION.

TABLE I



MOLYBDENUM
52---4
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
US
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP

52---5
MOLYBDENUM

MO

VO = 0.979 CC/G
VO1 = 0.9785 CC/G

CL = 6.45 KM/SEC
CS = 3.47 -

CO = 5.04 KM/SEC
CB = 5.19 -

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

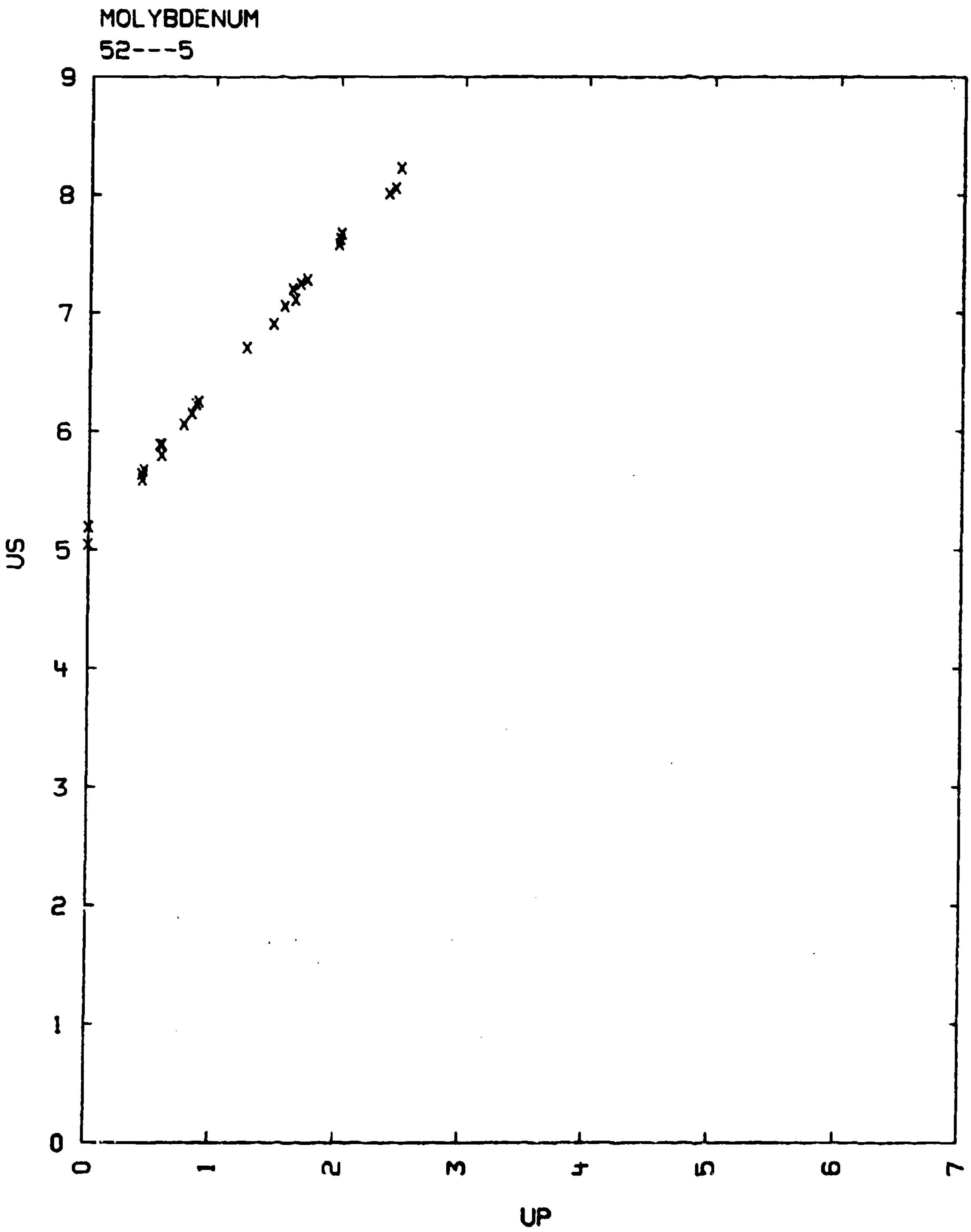
---SAMPLE---					---STANDARD---	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
10.200	5.19	0.	0.	1.0000	CB	0.
10.200	5.04	0.	0.	1.0000	CO	0.
10.200	5.63	0.42	241.	0.9254	2024 AL	6.44
10.200	5.58	0.43	245.	0.9229	2024 AL	6.45
10.220	5.66	0.45	260.	0.9205	CU	4.72
10.210	5.67	0.46	266.	0.9189	CU	4.74
10.200	5.88	0.57	342.	0.9031	2024 AL	6.81
10.200	5.79	0.59	348.	0.8981	2024 AL	6.83
10.210	5.88	0.59	354.	0.8997	CU	4.96
10.200	6.05	0.77	475.	0.8727	2024 AL	7.25
10.200	6.14	0.83	520.	0.8648	2024 AL	7.38
10.210	6.22	0.86	546.	0.8617	CU	5.39
10.220	6.23	0.87	554.	0.8604	CU	5.41
10.210	6.23	0.87	553.	0.8604	CU	5.41
10.210	6.24	0.89	567.	0.8574	CU	5.44
10.210	6.70	1.26	862.	0.8119	CU	6.04
10.210	6.90	1.48	1043.	0.7855	CU	6.36
10.210	7.05	1.56	1123.	0.7787	CU	6.49
10.200	7.20	1.63	1197.	0.7736	BRASS	6.45
10.200	7.21	1.64	1206.	0.7725	BRASS	6.46
10.200	7.11	1.65	1197.	0.7679	BRASS	6.46
10.210	7.25	1.69	1251.	0.7669	CU	6.70
10.210	7.28	1.75	1301.	0.7596	CU	6.78
10.210	7.57	1.99	1538.	0.7371	CU	7.15
10.200	7.56	2.00	1542.	0.7354	BRASS	7.00
10.200	7.62	2.00	1554.	0.7375	BRASS	7.01
10.200	7.66	2.01	1570.	0.7376	BRASS	7.02
10.210	8.01	2.39	1955.	0.7016	CU	7.75
10.210	8.05	2.44	2005.	0.6969	CU	7.82
10.210	8.22	2.49	2090.	0.6971	CU	7.91

US = 5.124 + 1.233*UP KM/SEC
SIGMA US = 0.047 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M.
AND CARTER, W.J.
HIGH VELOCITY IMPACT PHENOMENA, ED. KINSLOW (ACADEMIC PRESS
NEW YORK, 1970) CHAPTER VII: EOS OF SOLIDS FROM
SHOCK WAVE STUDIES
2) EXPERIMENTAL TECHNIQUE: B
DATA REDUCTION TECHNIQUE: B
3) V0I FROM WYCKOFF CRYSTAL STRUCTURES (JOHN WILEY AND SONS, N.Y.,
1963) VOL. 1.
4) V(DP/DE) = 1.52

TABLE I



53---1
TUNGSTEN

W

VO = 0.0521 CC/G. CO = 4.05 KM/SEC.
VOI = 0.0518 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC.
PRESSURES IN KILOBARS AND DENSITY IN G/CC.

TABLE

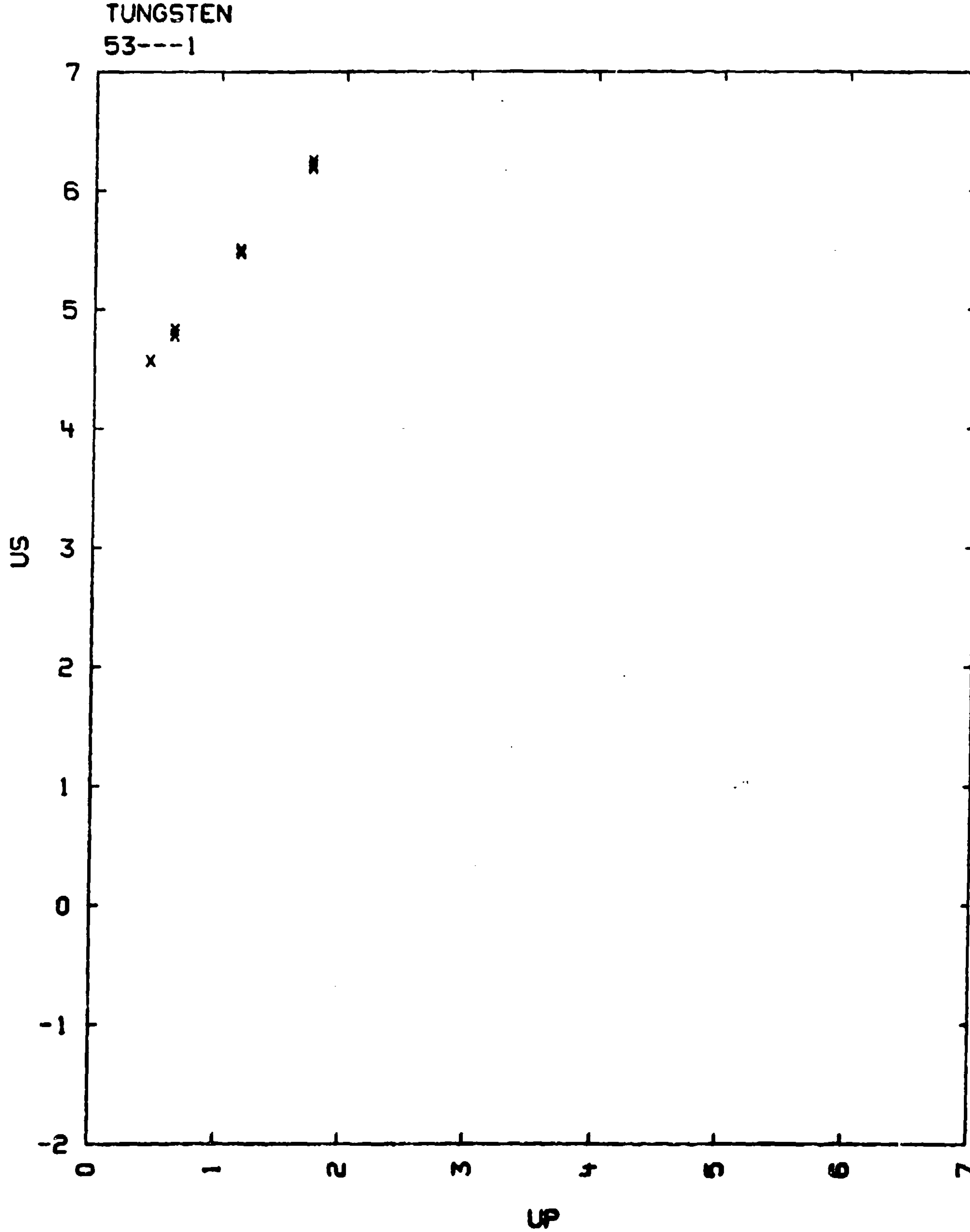
RHOO	US	UP	P	V/VO	PRESSURE IN STANDARD
19.17	4.56	0.45	[illegible]	0.901	218
-	4.55	0.45	394	0.901	218
-	4.78	0.64	587	0.866	320
-	4.82	0.64	590	0.868	320
-	5.47	1.17	1225	0.786	853
-	5.49	1.17	1227	0.788	853
-	6.21	1.73	2061	0.721	1430
-	6.19	1.73	2054	0.721	1427
-	6.24	1.73	2074	0.723	1426

US = 4.005 + 1.268*UP KM/SEC SIGMA US = 0.32 PERCENT

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
J. APPL. PHYS., VOL. 31, P. 1253 (1960)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS BRASS
3) FOR THE BRASS STANDARD DATA SEE SECTION 38-33---2
4) FOR P(STANDARD)=320 AND 218 THE STANDARD HAS AL. ABOVE THAT BRASS

TABLE 1



53---2

TUNGSTEN POROUS

W 99.8 PERCENT BY WEIGHT
MO TRACE
FE -
P -
CU -
O -

V0 = 0.0532 - 0.222 CC/G
V01 = 0.05192 CC/G

IN THE TABLES BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURES IN KILOBARS AND DENSITY IN G/CC. ST DESIGNATES THE STANDARD MATERIAL. P(ST) IS THE PRESSURE IN THE STANDARD PLATE.

TABLE

RHOO	US	UP	P	V/V0	ST	P(ST)
18.79	8.11	3.26	5010	0.5977	FE	3585
11.38	8.02	4.12	3760	0.4859	FE	3585
9.17	7.80	4.53	3240	0.4193	FE	3585
6.47	7.95	5.09	2620	0.3604	FE	3585
4.50	8.11	3.03	2030	0.3064	FE	3585
18.79	6.01	1.74	1980	0.7112	FE	1390
10.99	5.01	2.39	1320	0.5230	FE	1390
9.00	4.96	2.60	1160	0.4757	FE	1390
6.54	4.78	2.93	910	0.3880	FE	1390
10.99	2.56	1.12	315	0.5624	AL	258
6.32	2.29	1.51	219	0.3406	AL	258
4.85	2.28	1.87	185	0.2684	AL	258

US =

COMMENTS:

1) SOURCE: KRUPNIKOV, K. K., BRAZHNIK, M. I. AND KRUPNIKOVA V. P.
SOVIET PHYS.-JETP, VOL. 15, P. 470 (1962)
J. EXPTL. THEORET. PHYS. (U.S.S.R.) VOL. 47, P. 1202 (1964)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE B
3) CO, THE VELOCITY OF THE RAREFACTION HAVE MOVING PARALLEL TO THE SHOCK FRONT, HAS MEASURED ALSO. THESE RESULTS ARE GIVEN BELOW WITH THE MEASURED SHOCK VELOCITY AND PRESSURE.

TABLE

RHOO	US	P	CO	ST	P(ST)
10.75	7.84	[illegible]	7.19	FE	[illegible]
-	5.04	1310	5.61	FE	1390

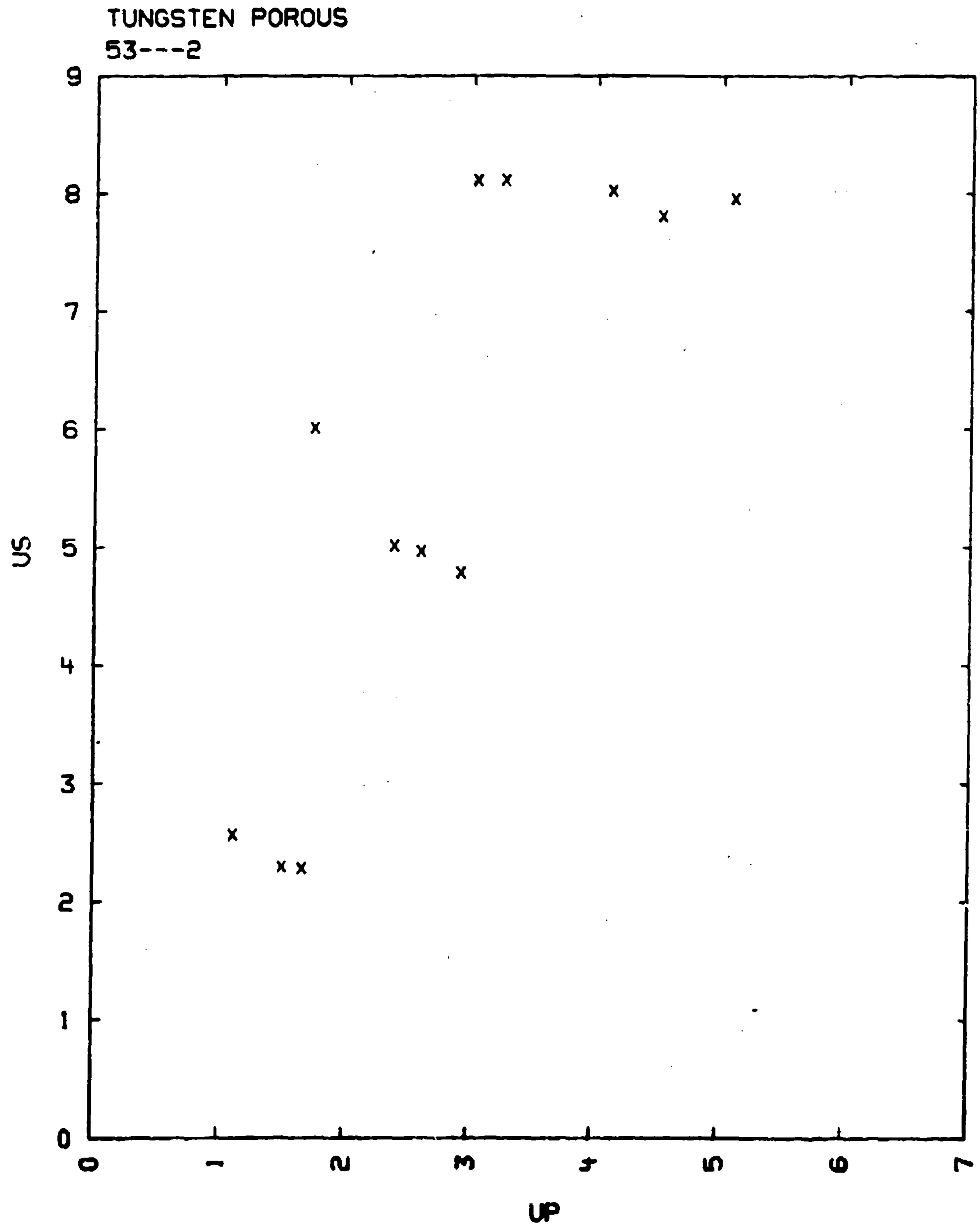
-	2.52	310	6.1	AL	258

4) THE MEASURED VALUE FOR CO AT THE LOWEST PRESSURE IS 6.1 KM/SEC. THIS IS REPRESENTIVE OF THE VELOCITY OF THE ELASTIC WAVE. THE CALCULATED PLASTIC WAVE VELOCITY CO = 4.79 KM/SEC.

5) THE EXPERIMENTAL TECHNIQUE USED IN THE DETERMINATION OF CO HAS DESCRIBED BY AL'TSHULER, KORMER, BRAZHNIK, VLADIMIROV, SPERANSKAYA, AND FUNTIKOV, SOVIET PHYS.-JETP, VOL. 38, P. 1061 (1960)

6) VOI HAS OBTAINED FROM THE CRYSTAL DATA DETERMINATIVE TABLES, AMERICAN CRYSTALLOGRAPHIC ASSOCIATION, 2ND. ED. (1963)

TABLE I



53---3
TUNGSTEN

W 99.95 PERCENT
FE 0.005 -
C 0.005 -
O2 0.005 -
H2 0.001 -
N2 0.005 -

V0 = 0.05216 CC/G
V01 = 0.05192 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN G/CC, VELOCITIES IN KM/SEC, AND PRESSURE IN KILOBARS.

TABLE

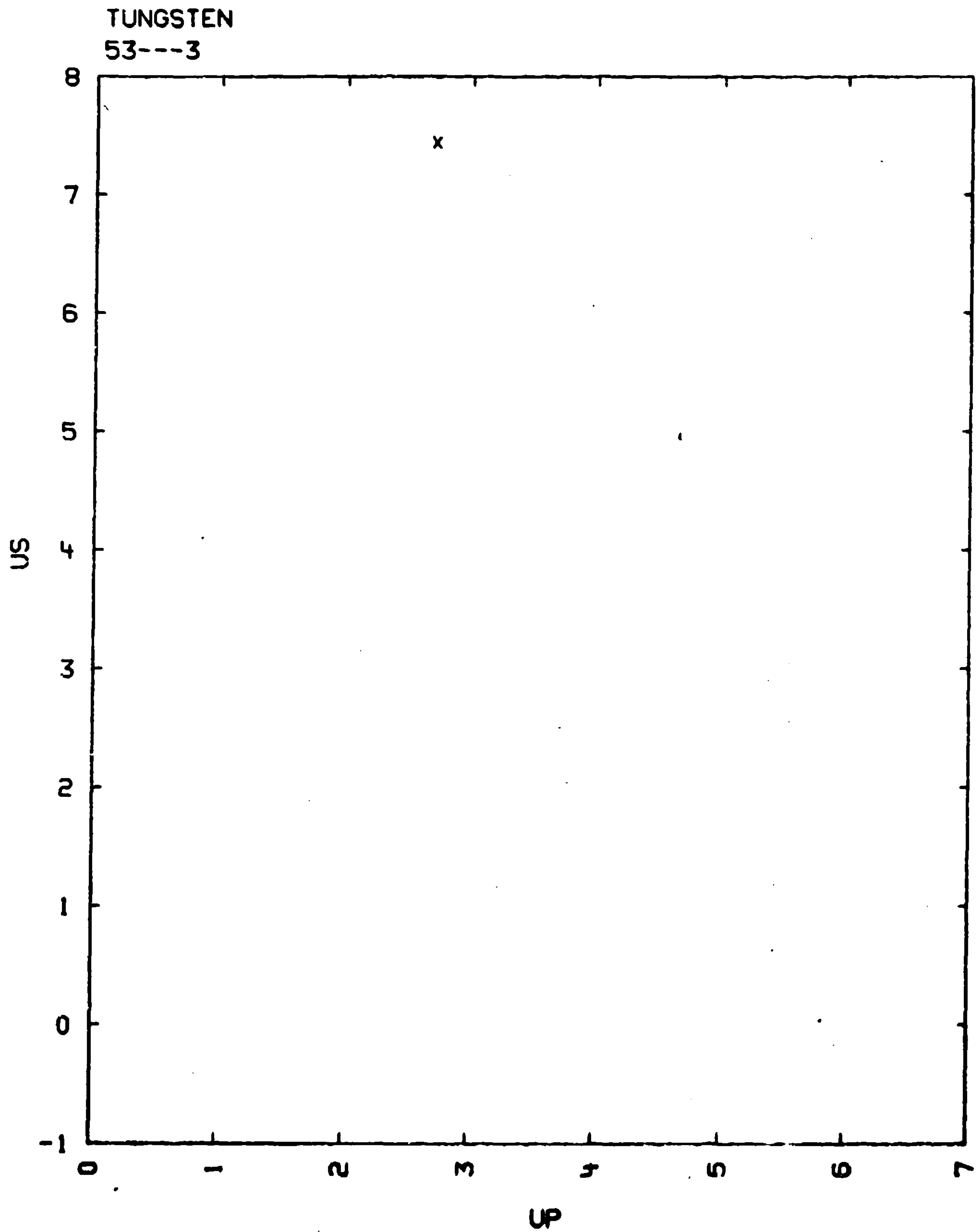
RHO0	US	UP	P	V/V0
19.17	7.44	2.71	3860	0.6358

US =

COMMENTS:

1) SOURCE: JONES, A. H., ISBELL, W. M. AND MAIDEN C. J.
JOURNAL OF APPLIED PHYSICS, VOL. 37, P. 3493 (1966).
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE A
STANDARD MATERIAL FANSTEEL 77. SEE MATERIAL 53--39--36---1.
3) THE DRIVER PLATE WAS ACCELERATED BY MEANS OF A LIGHT GAS GUN.
4) THE DRIVER PLATE VELOCITY AND SPATIAL ORIENTATION WERE MEASURED WITH TWO PULSED X-RAY STATIONS JUST BEFORE IMPACT.
5) FOR BOTH THE DRIVER PLATE IMPACT VELOCITY AND THE SAMPLE SHOCK VELOCITY THE MEASURED EXPERIMENTAL ERROR IS WITHIN 1 PERCENT.
6) V01 WAS TAKEN FROM THE CRYSTAL DATA DETERMINATIVE TABLES. AMERICAN CRYSTALLOGRAPHIC ASSOCIATION, 2ND. ED. (1963).

TABLE I



53---4
TUNGSTEN

	FOAM	COMPACTED	
NI FE MO	0.09	0.01	MOLE PERCENT
C	0.01		- -
O	0.37	0.0004	- -
W	REST	REST	

PARTICLE SIZE 5. TO 20. MICRONS

V0 = 0.05208 - 0.0709 CC/G
V01= 0.05192 CC/G

THE TABLE LISTS DENSITY IN G/CC, VELOCITIES IN KM/SEC AND PRESSURES IN KBAR. SEE COMMENT 6

TABLE

RHO0	US1	UP1	P1	V1/V0	US2	UP2	P2	V2/V0
19.2	4.84	0.039	36.0	0.992	4.41	0.338	289.5	0.923
-	4.77	0.039	36.1	0.992	4.15	0.121	101.0	0.971
-	4.87	0.039	36.3	0.992	4.24	0.129	109.8	0.971
-	4.91	0.037	35.2	0.992	4.25	0.213	178.9	0.950
-	4.83	0.038	35.5	0.992	4.27	0.077	67.4	0.982
14.3	4.10	0.019	11.2	0.995	1.68	0.421	107.2	0.753
14.2	3.74	0.018	9.8	0.995	1.88	0.506	139.3	0.734
14.2	3.51	0.020	9.8	0.994	1.63	0.419	101.9	0.746
14.4	3.71	0.019	10.0	0.995	1.15	0.153	31.9	0.877
14.1	3.73	0.018	9.6	0.995	1.33	0.323	66.0	0.765
14.5	3.61	0.017	8.8	0.995	1.51	0.354	82.2	0.770
14.2	3.74	0.016	8.3	0.996	1.93	0.505	141.9	0.740

US = 0.732 + 2.23*UP KM/SEC.
SIG US = 0.07 KM/SEC.

COMMENTS:

1) SOURCE: SCHMIDT, D.N. AND LINDE, R.K.
AIR FORCE WEAPONS LAB. REP. AFWL-TR-68-33 (1968)
CONTRACT NO. AF 29(601)-7238
SRI PROJECT: PGU-6127
STANFORD RES. INST., MENLO PARK, CALIFORNIA, U. S. A.
SEE ALSO J APPL. PHYS. 43 3387 (1972) FOR A DISCUSSION ON TUNGSTEN, COPPER AND POLYURETHANE.
2) EXPERIMENTAL TECHNIQUE: 11
DATA REDUCTION TECHNIQUE: C. WAVE PROFILES WERE BROAD BUT WERE APPROXIMATED BY A STEP FUNCTION MOVING AT THE AVERAGE WAVE VELOCITY LISTED
3) THE FOOT OF THE ELASTIC WAVE IS BETWEEN 1 AND 10 PERCENT FASTER THAN THE AVERAGE VELOCITY LISTED. THE PROFILE AND AVERAGE VELOCITY OF THE PLASTIC (CRUSHING) WAVE WAS INFERRED FROM THE STRESS-TIME PROFILE AT THE GUAGE-SAMPLE INTERFACE AND THE REVERBERATION TIME OF AN ELASTIC RELEASE WAVE REFLECTING OF THE CRUSHING WAVE.

4) ALL SAMPLES WERE COMPACTED AND SINTERED AT 2000 DEG. F.
THE HIGH DENSITY SAMPLES WERE HOT ROLLED IN ADDITION.
5) V0I WAS TAKEN FROM CRYSTAL DATA DETERMINATIVE TABLES, AMERICAN CRYSTALLOGRAPHIC ASSOCIATION, 2ND. ED. (1963)
6) NOTE THAT THE SECOND WAVE PARAMETERS IN THE TABLE REPRESENT A CRUSHING CURVE. P IS AN EFFECTIVE LONGITUDINAL STRESS OBTAINED BY CONSIDERING THE SAMPLE AS A HOMOGENEOUS ISOTROPIC MEDIUM.
7) THE ELASTIC WAVE PARAMETERS OF THE FIRST TABLE ENTRY WERE ASSUMED.

TABLE I

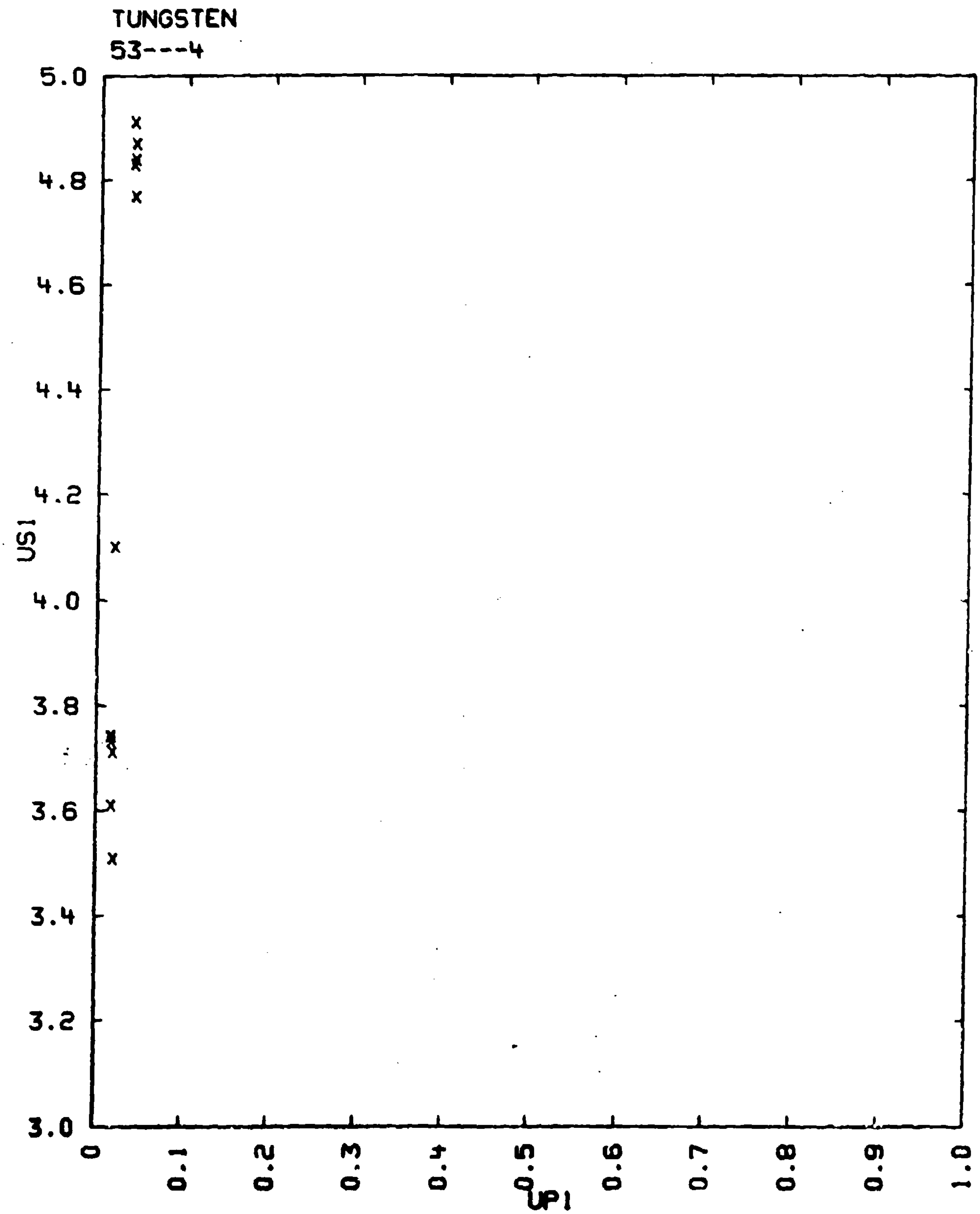
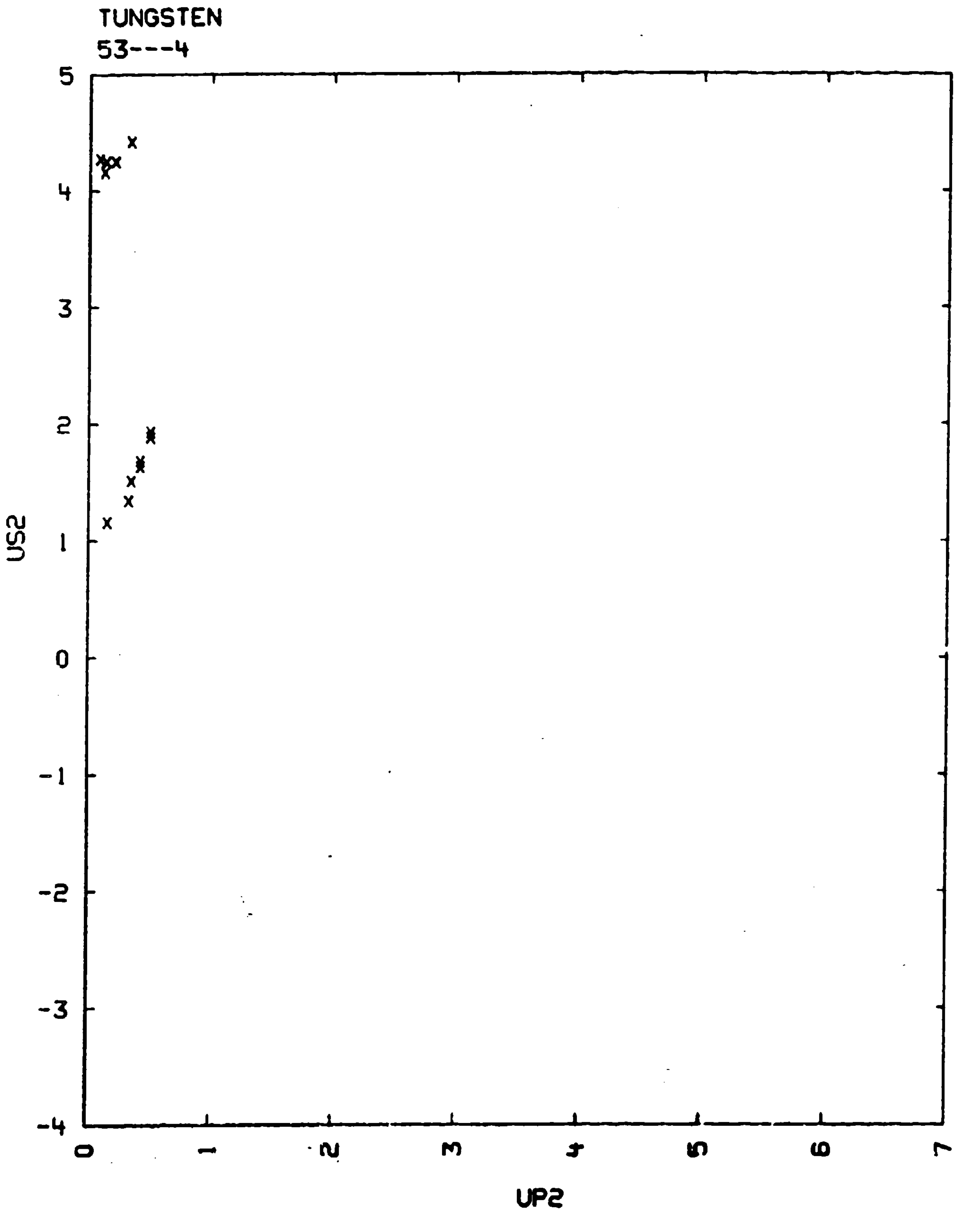

TUNGSTEN
53---4
US1
UP1
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

TABLE I



53---5
TUNGSTEN

W

V0 = 0.0521 CC/G   CL = 5.22 KM/SEC   C0 = 4.02 KM/SEC
V01 = 0.05192 CC/G CS = 2.89 KM/SEC   CB = 4.05 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

---SAMPLE---					---STANDARD---	
RHO0	US	UP	P	V/V0	MATERIAL	US(ST)
19.250	4.43	0.32	273.	0.9278	CU	4.64
19.250	4.45	0.36	308.	0.9191	CU	4.72
19.250	4.52	0.36	313.	0.9204	CU	4.74
19.270	4.52	0.37	322.	0.9181	CU	4.75
19.170	4.51	0.44	380.	0.9024	2024 AL	6.80
19.170	4.50	0.44	380.	0.9022	2024 AL	6.80
19.250	4.65	0.47	421.	0.8989	CU	4.96
19.170	4.77	0.62	567.	0.8700	2024 AL	7.34
19.170	4.73	0.62	562.	0.8689	2024 AL	7.34
19.256	4.92	0.69	654.	0.8598	CU	5.39
19.250	4.92	0.70	663.	0.8577	CU	5.41
19.250	4.92	0.70	663.	0.8577	CU	5.41
19.250	4.95	0.72	686.	0.8545	CU	5.44
19.170	5.42	1.13	1174.	0.7915	BRASS	6.07
19.170	5.40	1.13	1170.	0.7907	BRASS	6.07
19.250	5.80	1.38	1541.	0.7621	CU	6.70
19.250	5.84	1.43	1608.	0.7551	CU	6.78
19.250	6.05	1.64	1910.	0.7289	CU	7.15
19.250	6.05	1.64	1910.	0.7289	CU	7.15
19.170	6.12	1.68	1971.	0.7255	BRASS	7.08
19.170	6.14	1.69	1989.	0.7248	BRASS	7.09
19.170	6.17	1.69	1999.	0.7261	BRASS	7.10
19.250	6.42	1.98	2447.	0.6916	CU	7.75
19.250	6.45	2.02	2508.	0.6868	CU	7.82
19.250	6.56	2.06	2601.	0.6860	CU	7.91
19.250	6.65	2.07	2650.	0.6887	CU	7.94

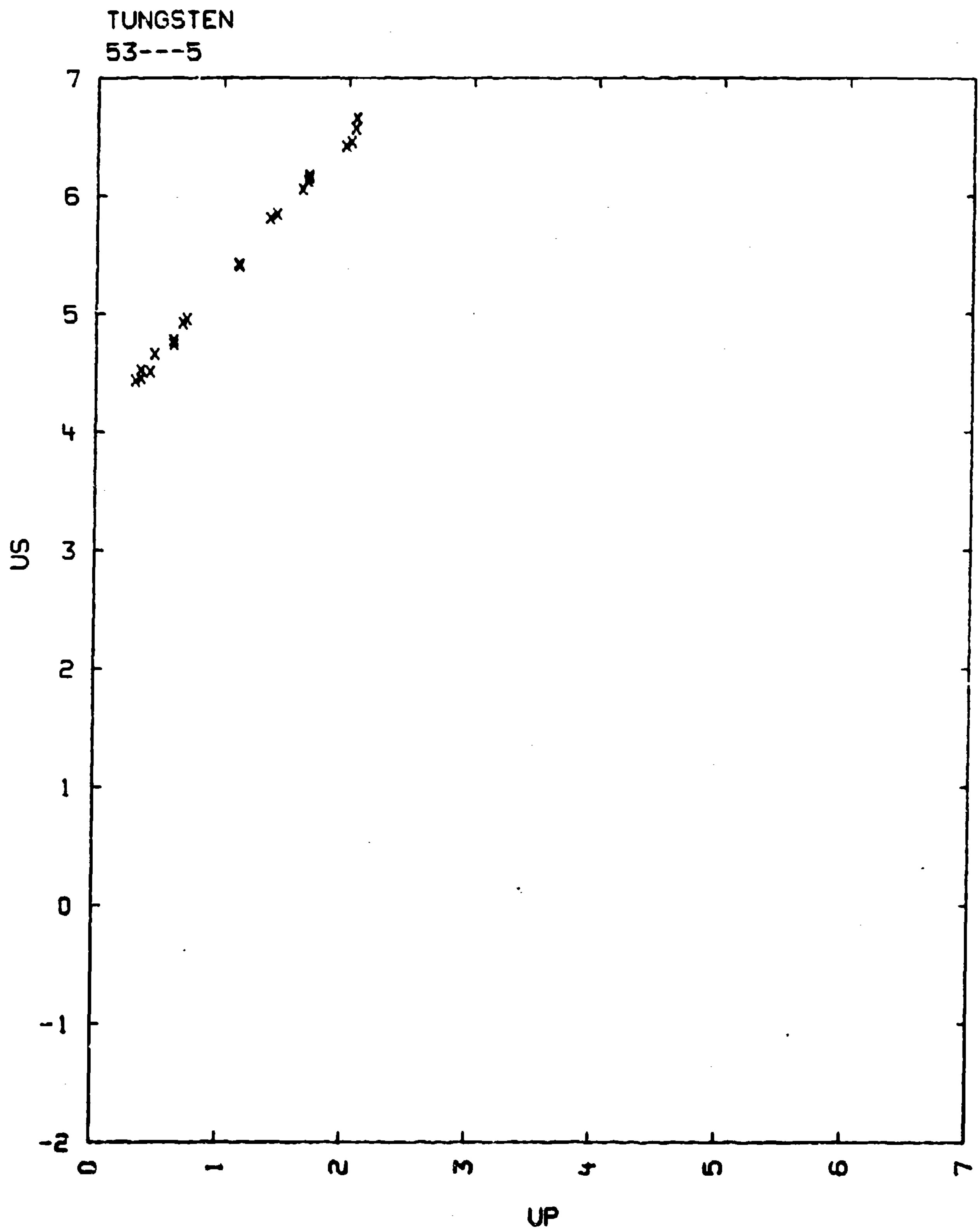
US = 4.029 + 1.237*UP KM/SEC
SIGMA US = 0.044 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.N., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES, HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC

PRESS, NEW YORK, 1970) CHAPTER VII
2) EXPERIMENTAL TECHNIQUE: B
DATA REDUCTION TECHNIQUE: B (STANDARD BASEPLATE AS SHOWN)
3) THE H.E.L. = 25-32 KBAR FOR A 5 MM THICK SAMPLE.
4) SAMPLES WERE ARC MELTED.
5) VOI FROM WYCKOFF, CRYSTAL STRUCTURES (JOHN WILEY AND SONS, N.Y. 1963) VOL. 1

TABLE I



54---1
VANADIUM

V

V0 = 0.164 CC/G
V01 = 0.1660 CC/G

C0 = 5.18 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC.
PRESSURES IN KILOBARS AND DENSITY IN G/CC

TABLE

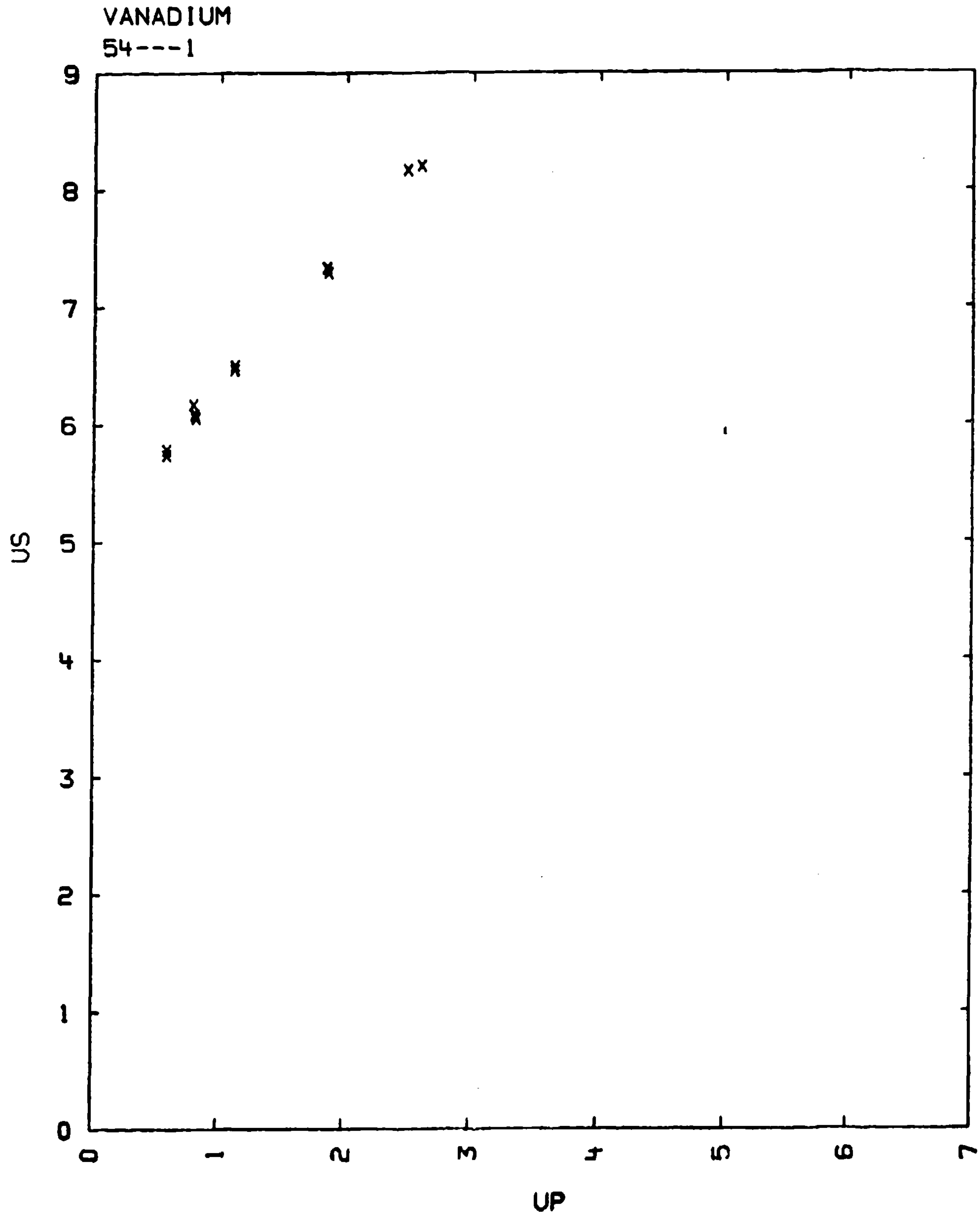
------ SAMPLE					STANDARD	
RHO0	US	UP	P	V/V0	P	MTRL.
6.10	5.78	0.58	204	0.900	149	AL
-	5.73	0.58	203	0.898	149	-
-	6.16	0.80	301	0.870	218	-
-	6.07	0.81	301	0.866	218	-
-	6.08	0.81	302	0.866	218	-
-	6.05	0.82	301	0.865	220	-
-	6.08	0.81	301	0.866	220	-
-	6.49	1.12	441	0.828	320	-
-	6.50	1.11	441	0.829	320	-
-	6.46	1.12	441	0.827	320	-
-	7.29	1.86	825	0.746	914	BRASS
-	7.28	1.86	825	0.745	914	-
-	7.32	1.85	828	0.747	914	-
-	7.34	1.85	829	0.748	914	-
-	8.20	2.59	1244	0.697	1378	-
-	8.17	2.49	1241	0.695	1378	-

US = 5.108 + 1.210 UP KM/SEC.   SIGMA US = 0.49 PER CENT

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
J. APPL. PHYS., VOL. 31; P. 1253 (1960)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS BRASS
3) FOR THE BRASS STANDARD DATA SEE MATERIAL 36-33
4) V01 WAS TAKEN FROM THE A. I. P. HANDBOOK (MCGRAW HILL BOOK CO.)
2ND ED.

TABLE I



54---2
VANADIUM

V

VO = 0.184 CC/G   CO = 5.14 KM/SEC
VOI = 0.16346 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

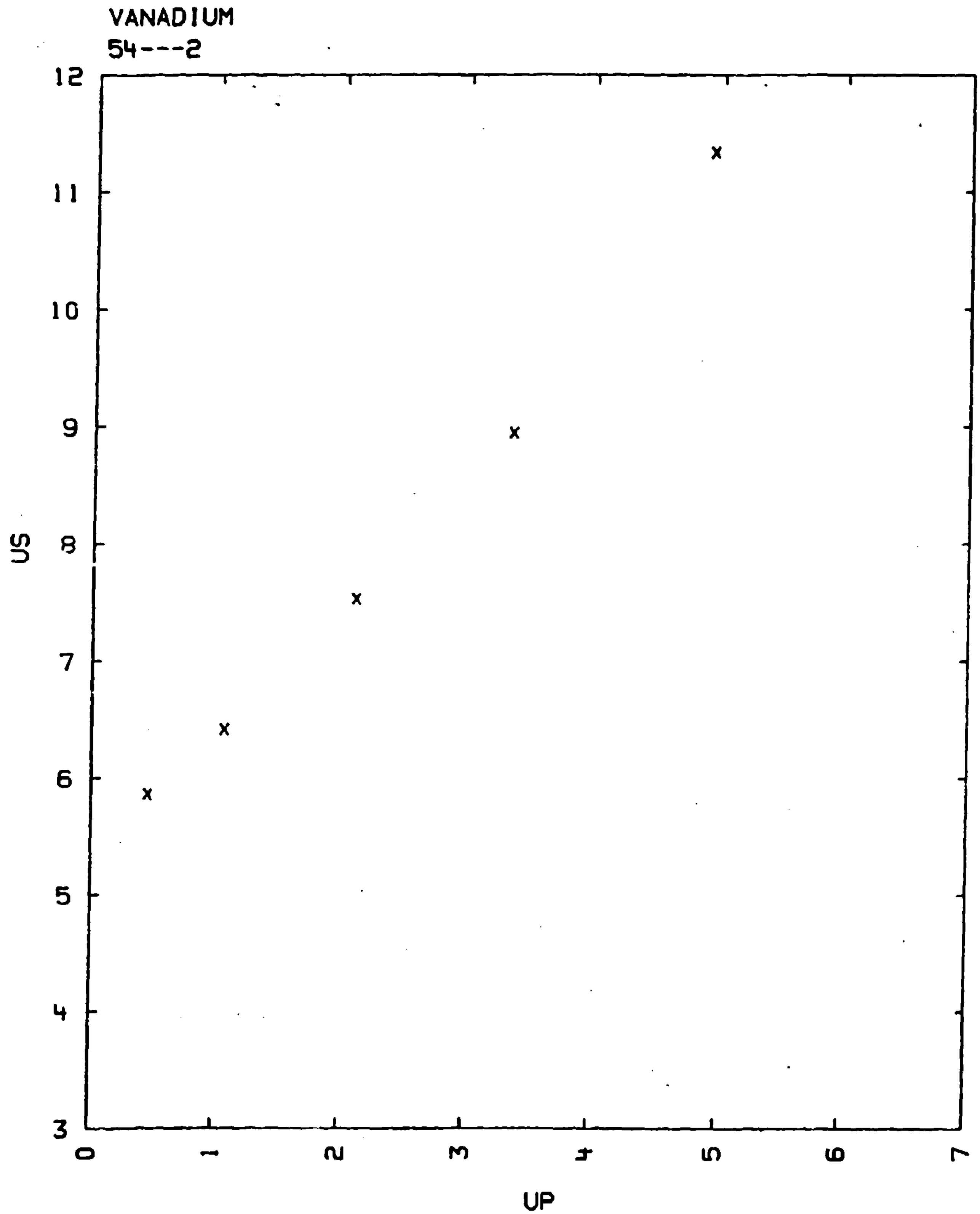
SAMPLE					STANDARD		
RHOO	US	UP	P	V/VO	MATERIAL	RHOO(ST)	US(ST)
6.08	11.33	4.92	3389.	0.566	IRON	7.85	11.21
-	8.94	3.37	1832.	0.623	IRON	7.85	8.83
-	7.53	2.12	970.	0.718	ALUMINUM	2.71	9.17
-	6.42	1.08	422.	0.832	ALUMINUM	2.71	7.34
-	5.86	0.46	164.	0.922	ALUMINUM	2.71	6.21

US = 5.34 + 1.031*UP   FOR UP BELOW 3.14 KM/SEC
US = 3.74 + 1.541*UP   FOR UP BETWEEN 3.14 AND 4.92 KM/SEC

COMMENTS:

1) SOURCE: ALTSHULER, L. V., BAKANOVA, A. A., DUDOLADOV, I. P.
ZHURNAL EKSP. TEORET. FIZIKI V. 53, P. 1967 (1967).
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) ONLY SHOCK VELOCITIES WERE MEASURED TO DETERMINE THE STRESS STATES. THE UNCERTAINTY IN THE SHOCK VELOCITIES WAS ESTIMATED TO BE 1.0 PERCENT.
4) HUGONIOTS OF STANDARD MATERIALS USED WERE AS FOLLOWS
ALUMINUM US = 5.25 + 1.39*UP FOR UP BETWEEN 0.0 AND 6.0 KM/SEC
IRON US = 3.85 + 1.615*UP FOR UP BETWEEN 1.0 AND 4.6 KM/SEC
5) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANT OF THE CUBIC BODY-CENTERED STRUCTURE,
A = 3.0240 ANGSTROMS (25 DEG. C)
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SIDNEY, 1963) 2ND EDITION, VOL. 1, P. 16.
6) THE AUTHORS OBTAINED THE VALUE OF CO FROM HANDBOOK OF RARE METALS, (MIR PUBLISHERS, USSR, 1963) OR FROM C. KITTEL, INTRODUCTION TO SOLID STATE PHYSICS (FIZMATGIZ, USSR, 1963).
7) THE DISCONTINUITY OF THE US VS. UP PLOT AT UP = 3.14 KM/SEC IS ATTRIBUTED TO AN ELECTRONIC PHASE CHANGE.

TABLE I



54---3
VANADIUM

V

V0 = 0.1639 CC/G
V01 = 0.1635 CC/G

CB = 5.18 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

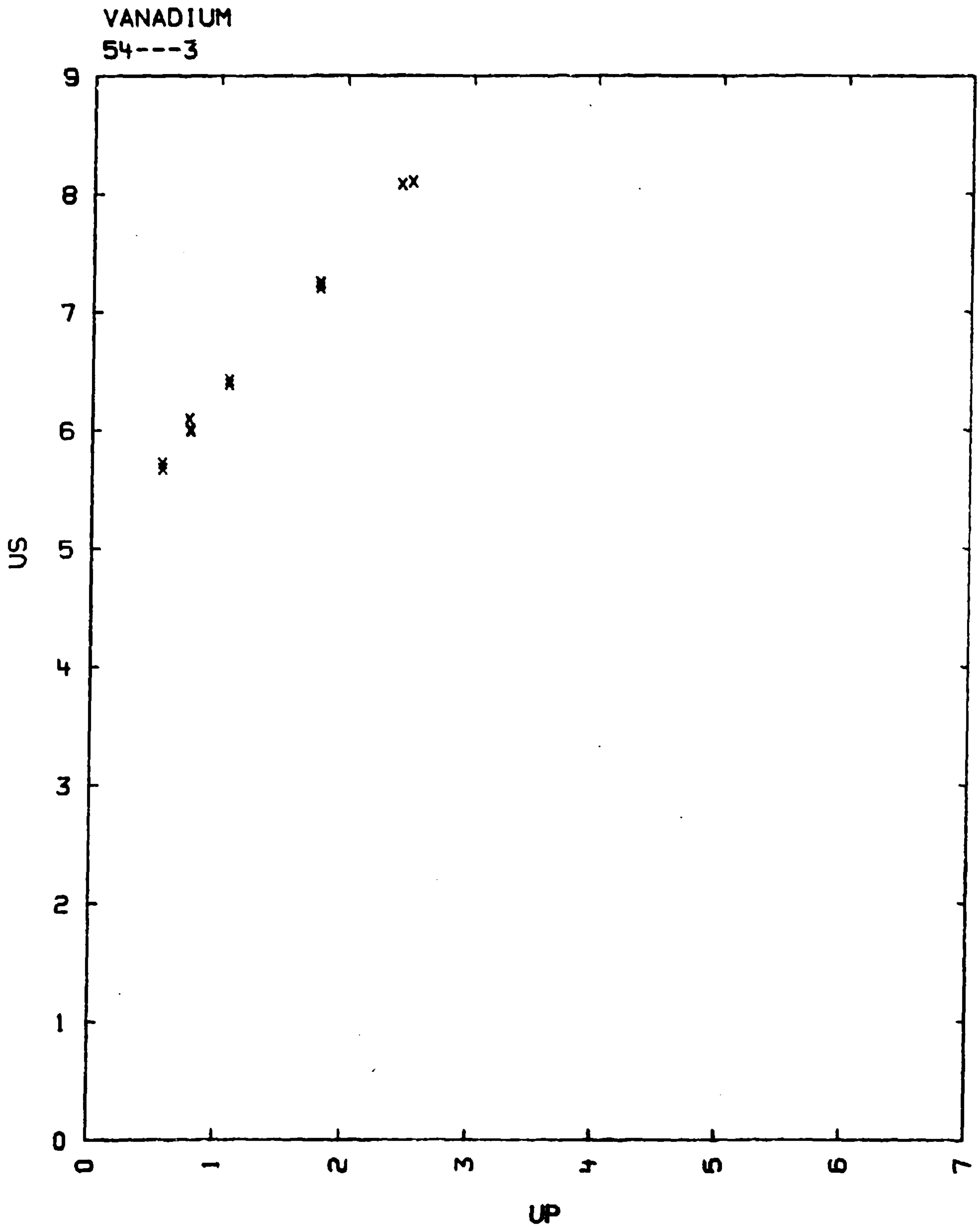
-----SAMPLE-----					-----STANDARD-----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
6.100	5.71	0.56	195.	0.9019	2024 AL	6.39
6.100	5.66	0.56	193.	0.9011	2024 AL	6.39
6.100	6.08	0.78	289.	0.8717	2024 AL	6.81
6.100	6.00	0.79	289.	0.8683	2024 AL	6.81
6.100	6.00	0.79	289.	0.8683	2024 AL	6.81
6.100	6.00	0.79	289.	0.8683	2024 AL	6.81
6.100	5.98	0.79	288.	0.8679	2024 AL	6.81
6.100	6.42	1.09	427.	0.8302	2024 AL	7.35
6.100	6.41	1.09	426.	0.8300	2024 AL	7.35
6.100	6.38	1.09	424.	0.8292	2024 AL	7.35
6.100	7.25	1.80	796.	0.7517	BRASS	6.18
6.100	7.23	1.80	794.	0.7510	BRASS	6.18
6.100	7.20	1.80	791.	0.7500	BRASS	6.18
6.100	7.19	1.80	789.	0.7497	BRASS	6.18
6.100	8.07	2.43	1196.	0.6989	BRASS	7.01
6.100	8.10	2.52	1245.	0.6889	BRASS	7.12

US = 5.077 + 1.201*UP KM/SEC
SIGMA US = 0.042 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES, HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII
2) EXPERIMENTAL TECHNIQUE: B
DATA REDUCTION TECHNIQUE: B
3) V01 FROM WYCKOFF, CRYSTAL STRUCTURES (JOHN WILEY AND SONS, N.Y., 1963) VOL. 1
4) V(DP/DE) = 1.29

TABLE I



55---1
NIOBIUM

NB---99.8 PER CENT OR GREATER

V0 = 0.1162 CC/G.
V01 = 0.1167 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURE IN KILOBARS, AND DENSITY IN G/CC.

TABLE

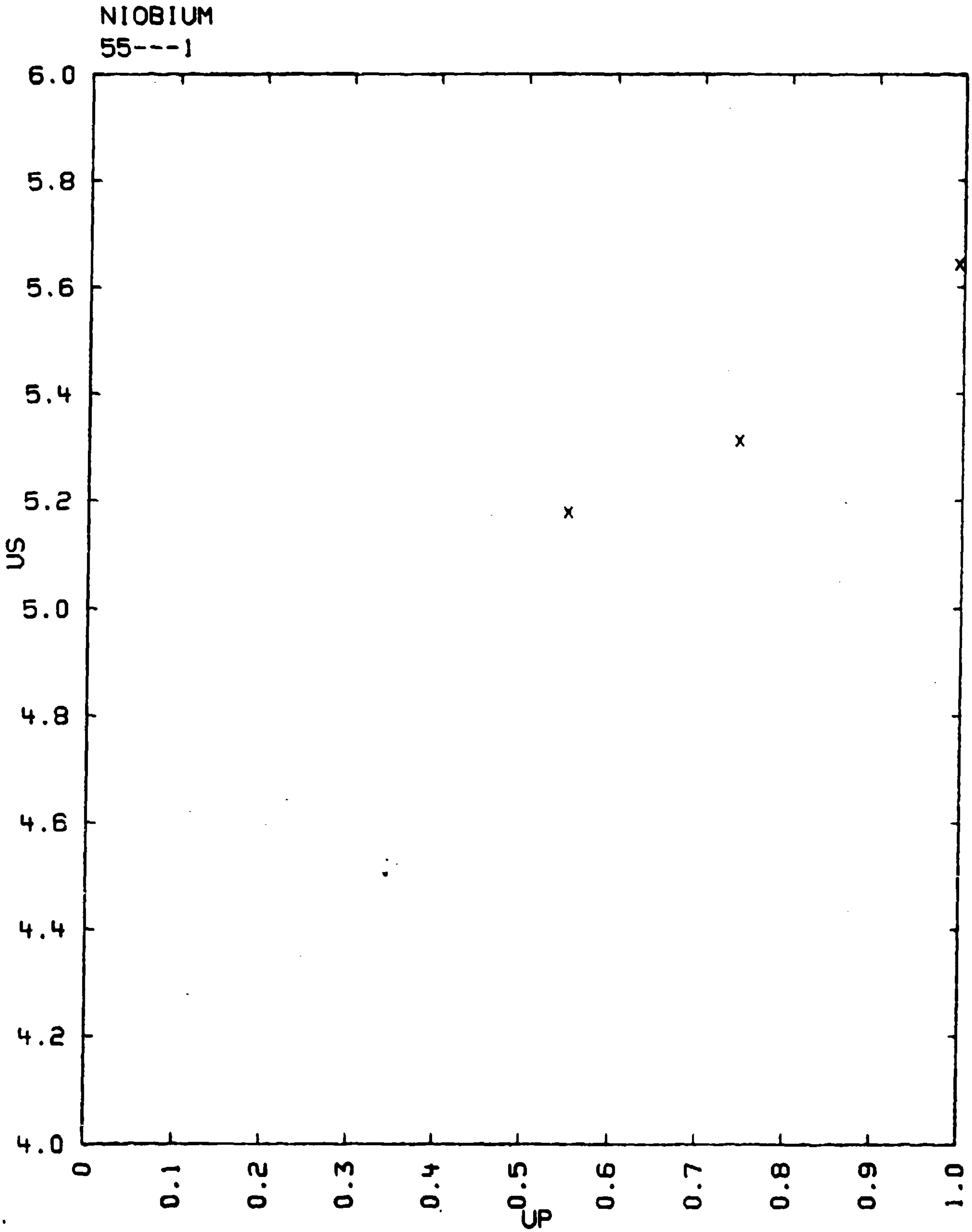
RHO0	US	UP	P	V/V0
8.604	5.177	0.5489	244.5	0.8940
-	5.311	0.7434	341	0.8606
-	5.642	0.9929	482	0.8240

US = 4.569 + 1.060 UP KM/SEC   SIGMA US = 1.1 PERCENT

COMMENTS:

1) SOURCE: WALSH, J. M., RICE, M. H., MCQUEEN, R. G. AND YARGER, F. L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 1 PERCENT IN COMPRESSION AT A GIVEN PRESSURE.
4) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS.

TABLE I


NIOBIUM
55---1
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
US
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP

55---2
NIOBIUM

NB 99.5 PERCENT OR GREATER

VO = 0.1165 CC/G. CL = 5.02 KM/SEC. CO = 4.39 KM/SEC.
VOI = 0.1162 CC/G. CS = 2.11 KM/SEC. CB = 4.43 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITIES IN G/CC.

TABLE

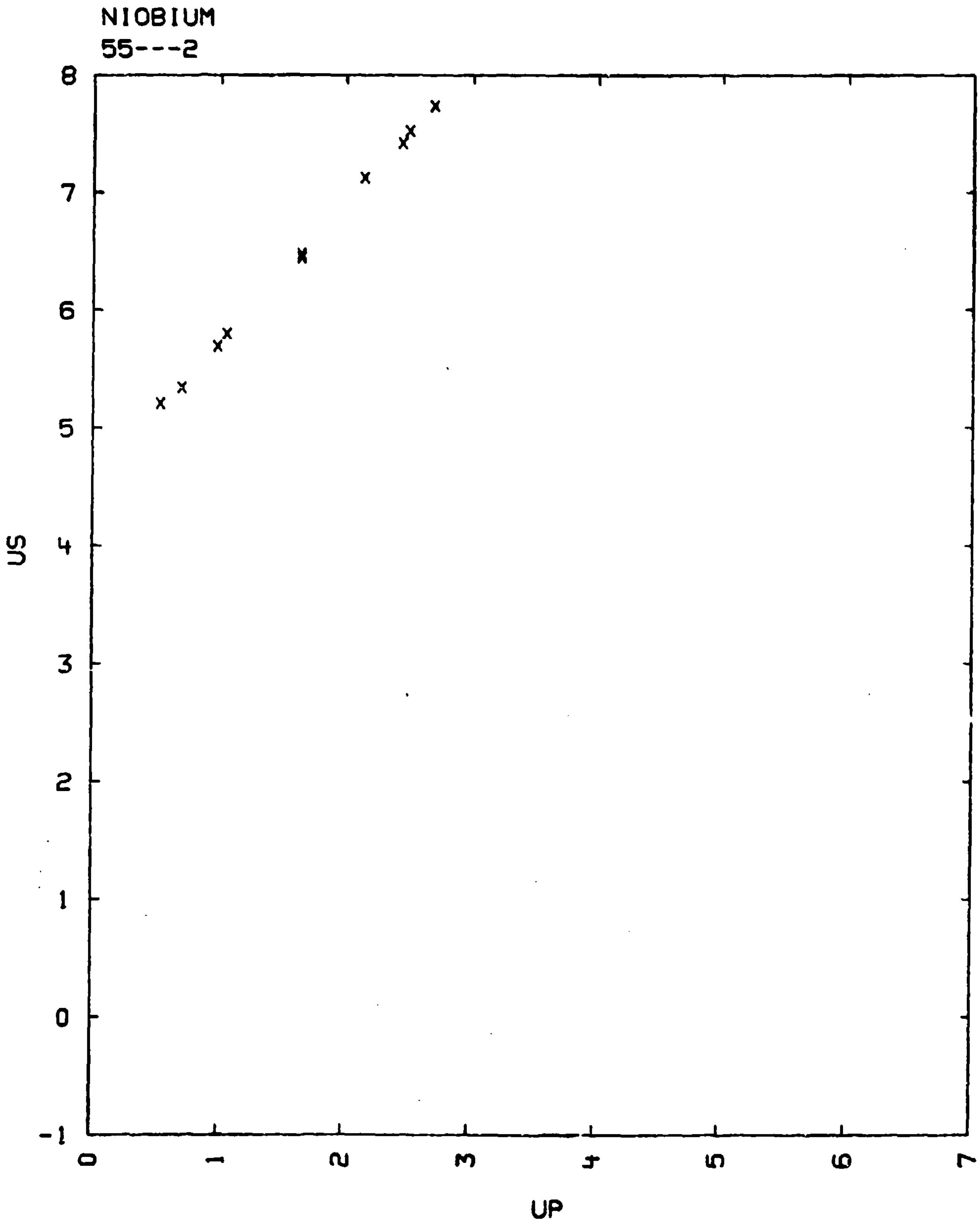
SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	RHOO	US
8.583	5.195	0.527	235.0	0.8986	8.932	4.764
-	5.335	0.706	323.4	0.8677	8.934	5.024
-	5.687	0.978	477.4	0.8280	-	5.426
-	5.793	1.061	527.5	0.8168	-	5.548
-	6.449	1.643	909.5	0.7452	-	6.387
-	6.432	1.650	910.6	0.7435	-	6.393
-	6.471	1.651	916.4	0.7449	-	6.400
-	7.114	2.158	1317.8	0.6966	-	7.133
-	7.417	2.450	1557.5	0.6697	-	7.494
-	7.518	2.508	1618.7	0.6664	-	7.632
-	7.734	2.705	1795.8	0.6503	-	7.910

US = 4.464 + 1.216 UP KM/SEC.

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
REPORT NO. GMX-6-566, PP. 51-62 (1964)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS 2024 ALUMINUM
3) THE ALUMINUM HUGONIOT IS REPRESENTED BY
US = 5.355 + 1.345 UP KM/SEC
THE PARTIAL (DE/DP)V = 0.162 CUBIC CM.
4) VOI WAS TAKEN FROM THE AMERICAN INSTITUTE OF PHYS. HANDBOOK (MCGRAW-HILL BOOK CO. N.Y., 1963) 2ND ED.

TABLE I



55---3
NIOBIUM

NB

VO = 0.117 CC/G
VOI = 0.11652 CC/G

CO = 4.48 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

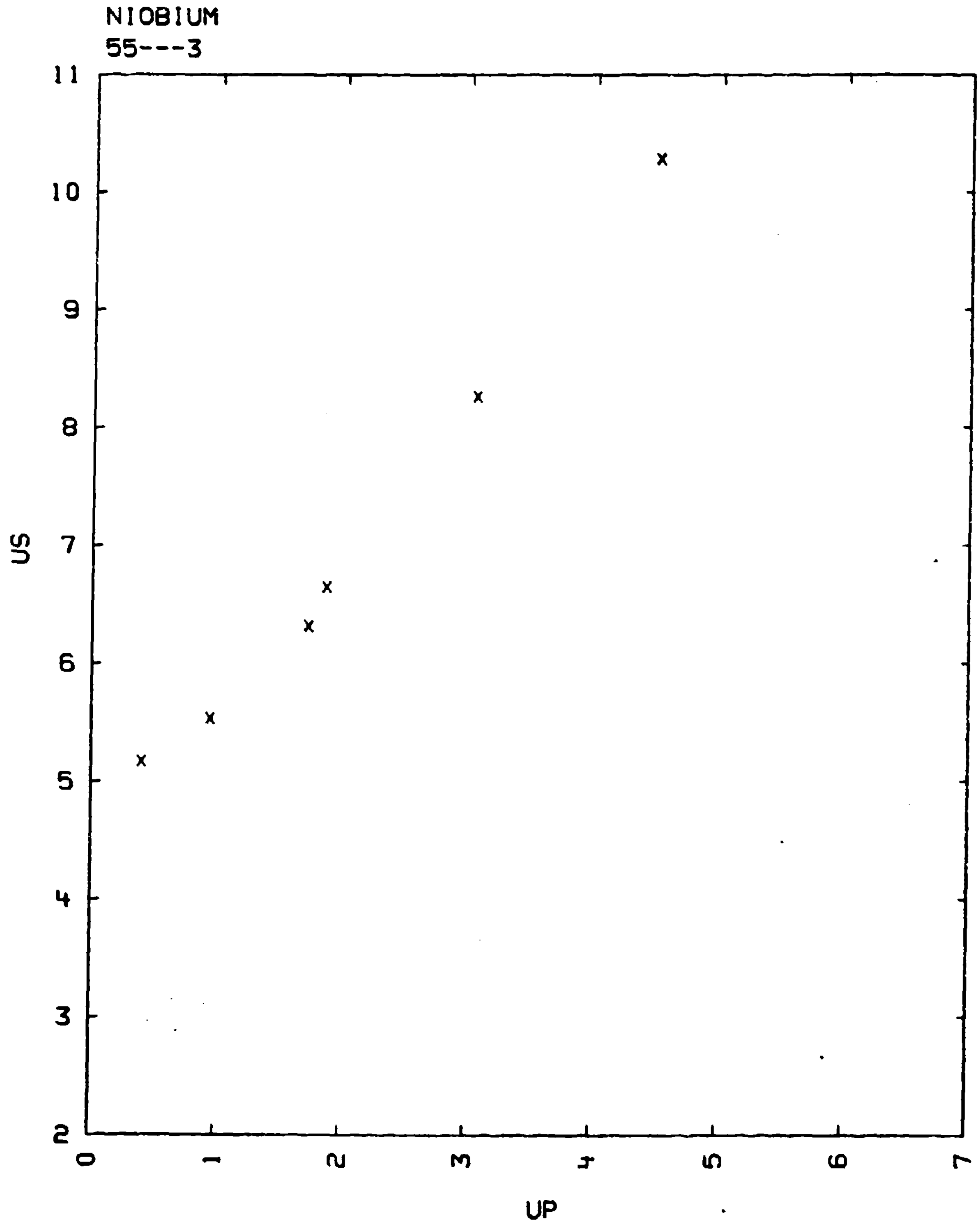
SAMPLE					STANDARD		
RHOO	US	UP	P	V/VO	MATERIAL	RHOO(ST)	US(ST)
8.58	10.28	4.50	3970.	0.562	IRON	7.85	11.21
-	8.26	3.06	2169.	0.630	IRON	7.85	8.83
-	6.64	1.87	1065.	0.718	ALUMINUM	2.71	9.17
-	6.31	1.73	337.	0.726	COPPER	8.93	6.45
-	5.53	0.95	450.	0.829	ALUMINUM	2.71	7.34
-	5.17	0.40	177.	0.923	ALUMINUM	2.71	6.21

US = 4.70 + 0.920*UP KM/SEC FOR UP BELOW 1.62 KM/SEC
US = 3.91 + 1.409*UP KM/SEC FOR UP BETWEEN 1.62 AND 4.50 KM/SEC

COMMENTS:

1) SOURCE: ALTSHULER, L. V., BAKANOVA, A. A., DUDOLADOV, I. P.
ZHURNAL EKSP. TEORET. FIZIKI V. 53, P. 1967 (1967).
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) ONLY SHOCK VELOCITIES WERE MEASURED TO DETERMINE THE STRESS STATES. THE UNCERTAINTY IN THE SHOCK VELOCITIES WAS ESTIMATED TO BE 1.0 PERCENT.
4) HUGONIOTS OF STANDARD MATERIALS USED WERE AS FOLLOWS
ALUMINUM US = 5.25 + 1.39*UP FOR UP BETWEEN 0.0 AND 6.0 KM/SEC
COPPER US = 3.95 + 1.50*UP FOR UP BETWEEN 0.0 AND 4.0 KM/SEC
IRON US = 3.85 + 1.615*UP FOR UP BETWEEN 1.0 AND 4.6 KM/SEC
5) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANT OF THE CUBIC BODY-CENTERED STRUCTURE,
A = 3.3004 ANGSTROMS (18 DEG. C)
NEW YORK, LONDON, SIDNEY, 1963) 2ND EDITION, VOL. 1, P. 16.
6) THE AUTHORS OBTAINED THE VALUE OF CO FROM HANDBOOK OF RARE METALS, (MIR PUBLISHERS, USSR, 1963) OR FROM C. KITTEL, INTRODUCTION TO SOLID STATE PHYSICS (FIZMATGIZ, USSR, 1963).
7) THE DISCONTINUITY OF THE US VS. UP PLOT AT UP = 1.62 KM/SEC IS ATTRIBUTED TO AN ELECTRONIC PHASE CHANGE.

TABLE I



55---4
NIOBIUM

NB

VO = 0.1168 CC/G   CL = 5.03 KM/SEC   CO = 4.39 KM/SEC
VOI = 0.1165 CC/G   CS = 2.11 KM/SEC   CB = 4.43 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

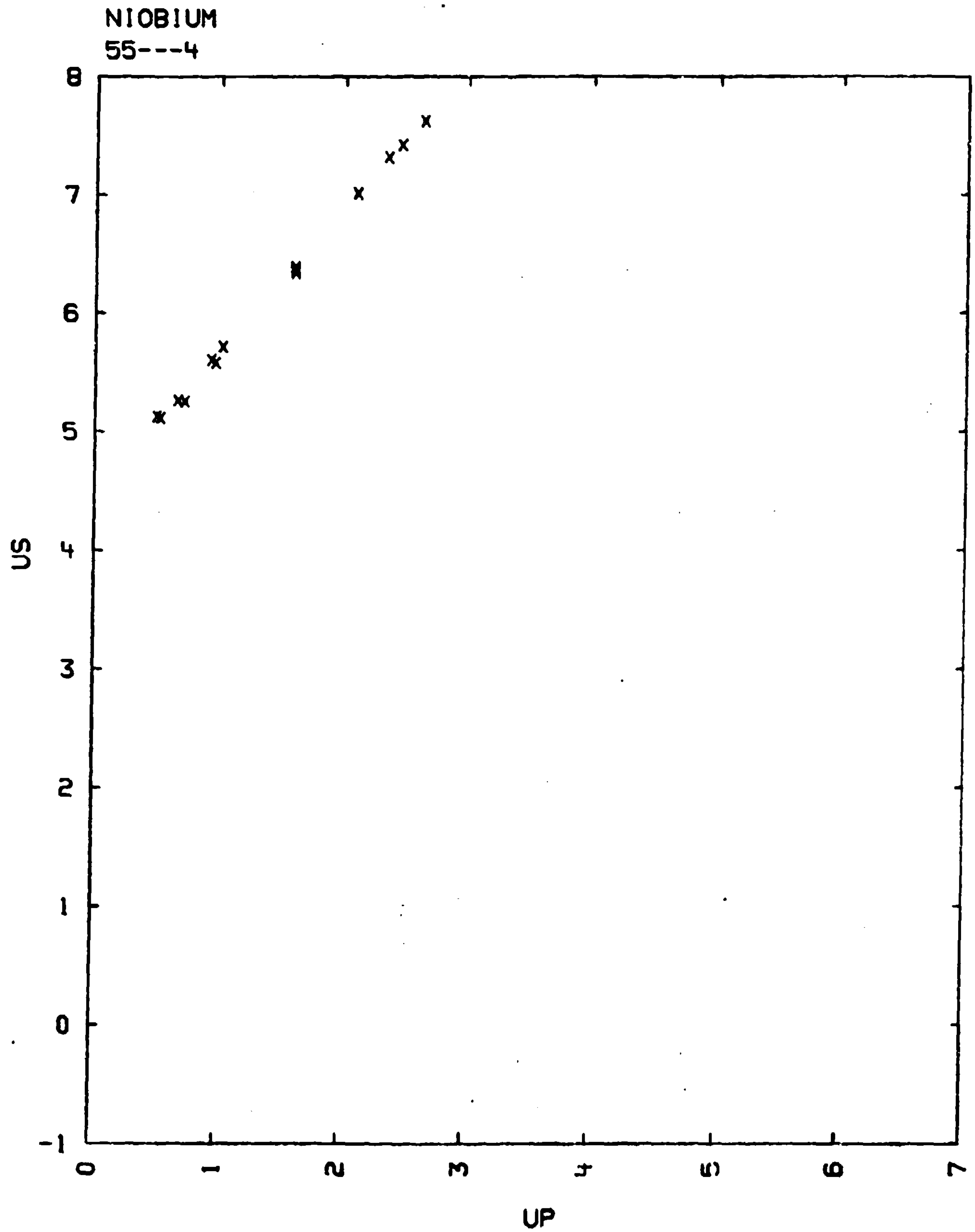
-----SAMPLE-----					-----STANDARD-----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
8.583	5.12	0.50	220.	0.9023	CU	4.70
8.604	5.11	0.53	233.	0.8963	2024 AL	6.49
8.586	5.26	0.67	303.	0.8726	CU	4.95
8.604	5.25	0.72	325.	0.8629	2024 AL	6.86
8.584	5.60	0.94	452.	0.8321	CU	5.35
8.604	5.57	0.97	465.	0.8259	2024 AL	7.36
8.583	5.71	1.02	500.	0.8214	CU	5.47
8.584	6.36	1.60	874.	0.7484	CU	6.29
8.580	6.34	1.61	876.	0.7461	CU	6.30
8.578	6.38	1.61	881.	0.7476	CU	6.31
8.584	7.01	2.11	1270.	0.6990	CU	7.03
8.571	7.31	2.36	1479.	0.6772	CU	7.39
8.585	7.41	2.46	1565.	0.6680	CU	7.52
8.584	7.62	2.65	1733.	0.6522	CU	7.80

US = 4.438 + 1.207*UP KM/SEC
SIGMA US = 0.037 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES. HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII
2) EXPERIMENTAL TECHNIQUE: B
DATA REDUCTION TECHNIQUE: B
3) VOI IS FROM WYCKOFF CRYSTALL STRUCTURES (JOHN WILEY AND SONS, N.Y., 1963) V. 1
4) V(DP/DE) = 1.47
5) HUGONIOT ELASTIC LIMIT 20.7 KBAR

TABLE I



56---1
TANTALUM

TA 99.8 PER CENT OR GREATER

VO = 0.06075 CC/G. CL = 3.35 KM/SEC.
VOI = 0.05848 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURE IN KILOBARS, AND DENSITY IN G/CC.

TABLE

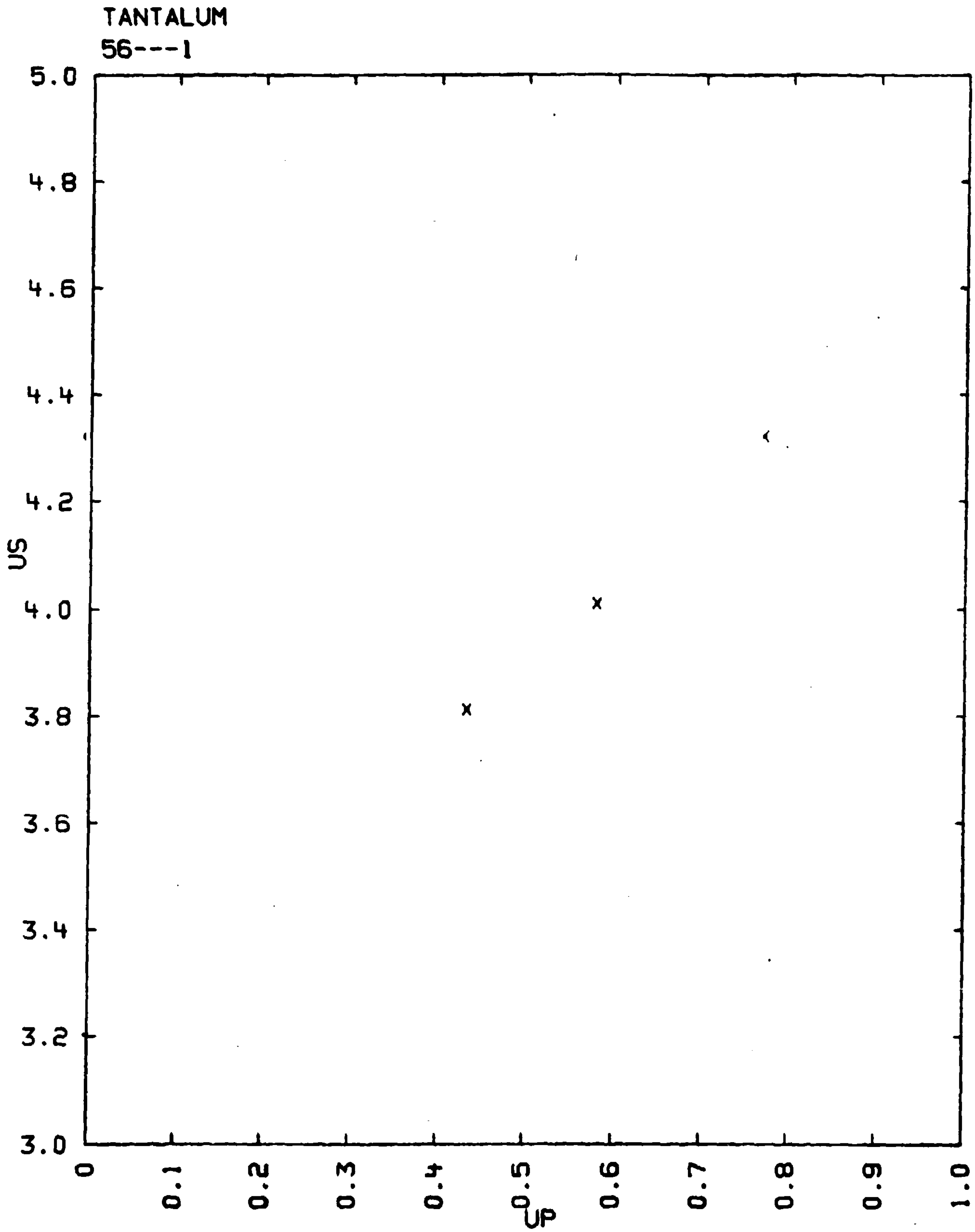
RHOO	US	UP	P	V/VO
16.46	3.811	0.4327	271.5	0.8865
-	4.010	0.5800	383	0.8554
-	4.323	0.7685	547	0.8222

US = 3.139 + 1.531 UP   SIGMA = 0.5 PERCENT

COMMENTS:

1) SOURCE: WALSH, J. M., RICE, M. H., MCQUEEN, R. G. AND YARGER, F. L.
   PHYS. REV., VOL. 108, P. 169 FF. (1957)
   LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
   DATA REDUCTION TECHNIQUE B
   STANDARD MATERIAL 24ST ALUMINUM
3) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 3 PER CENT IN COMPRESSION AT A GIVEN PRESSURE.
4) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS
5) CL OBTAINED FROM L. BERGMAN, DER ULTRASCHALL,
   (S. HIRZEL VERLAG, STUTTGART, GERMANY, 1954) 6TH ED., P. 650

TABLE I



TANTALUM
56---1
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
US
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP

56---2
TANTALUM

TA 99.5 PERCENT OR GREATER

VO = 0.0600 G/CC.   CL = 4.15 KM/SEC.   CO = 3.39 KM/SEC.
VOI = 0.0585 G/CC.   CS = 2.07 KM/SEC.   CB = 3.41 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	RHOO	US
16.66	3.981	0.429	284.5	0.8922	8.932	4.784
-	4.134	0.576	396.2	0.8607	8.934	5.024
-	4.395	0.804	588.3	0.8171	-	5.426
-	4.495	0.872	653.0	0.8060	-	5.548
-	5.092	1.358	1152.0	0.7333	-	6.393
-	5.061	1.359	1145.2	0.7315	-	6.387
-	5.621	1.790	1676.3	0.6816	-	7.133
-	5.889	2.003	1962.8	0.6599	-	7.494
-	5.967	2.087	2074.7	0.6502	-	7.632
-	6.103	2.262	2298.5	0.6294	-	7.910

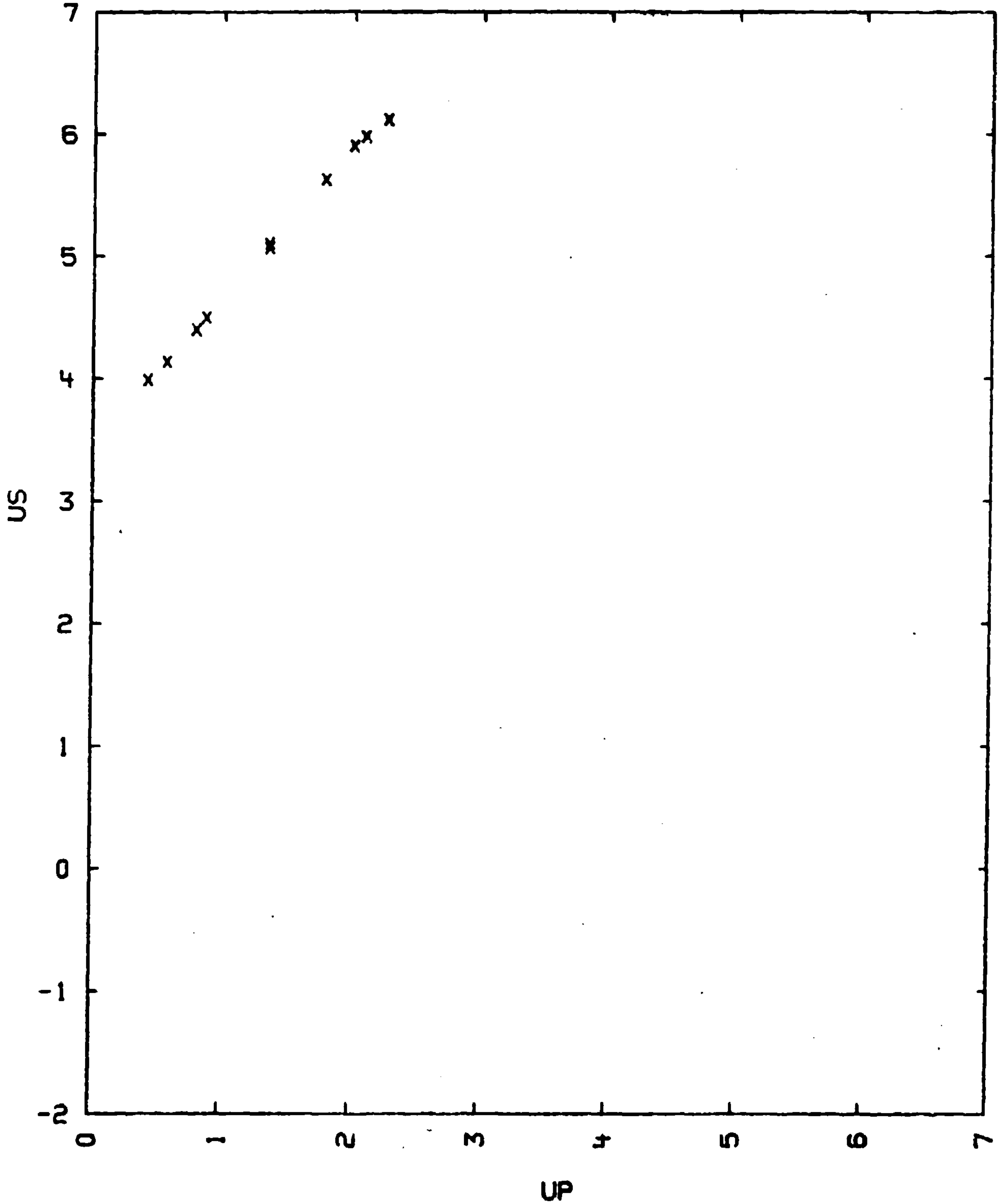
US = 3.453 + 1.197 UP, SIG.US = 0.029 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
REPORT NO. GMX-6-566, PP. 51-62 (1964)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS COPPER
3) COPPER HUGONIOT IS REPRESENTED BY:
US = 3.958 + 1.497 UP KM/SEC.
THE PARTIAL (DE/DP)V = 0.0562 CUBIC CM.
4) VOI HAS TAKEN FROM THE AMERICAN INSTITUTE OF PHYS. HANDBOOK (MCGRAW-HILL BOOK CO. N.Y., 1963) 2ND ED.
5) A HUGONIOT ELASTIC LIMIT OF 17 KBAR HAS BEEN MEASURED BY
R. HASLEY AND K.G. HOGE, CHEM. TECH. NOTE 292, LAWRENCE LIVERMORE LAB LIVERMORE CAL.

TABLE 1

TANTALUM
56---2



56---3
TANTALUM

TA

V0 = 0.0602 G/CC.
V0I = 0.05994 G/CC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC. ST DESIGNATES THE STANDARD MATERIAL USED AS STRIKER PLATE. U(ST) IS THE VELOCITY BEFORE IMPACT.

TABLE

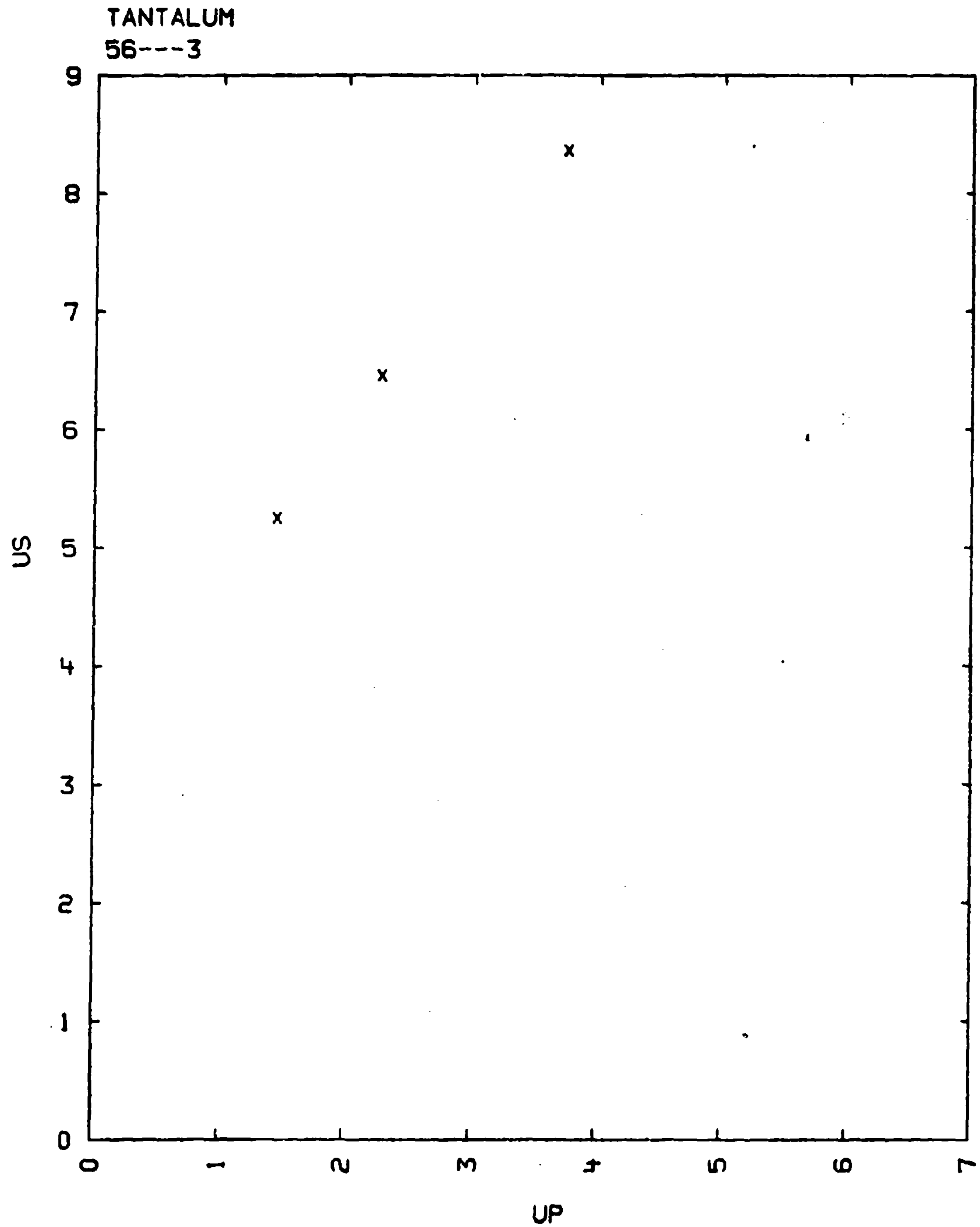
RHO0	US	UP	P	V/V0	ST	U(ST)
16.6	5.24	1.45	1245	0.7231	AL	5.60
-	6.45	2.28	2409	0.6464	FE	5.60
-	8.36	3.74	5121	0.5525	FE	9.10

US = 3.31 + 1.36 UP KM/SEC. FOR UP BETWEEN 1.45 TO 3.74 KM/SEC.
SIGMA US = 0.06 KM/SEC.

COMMENTS:

1) SOURCE: KRUPNIKOV, K. K., BAKANOVA, A. A., BRAZHNIK, M. I. AND TRUNIN, R. F.
SOVIET PHYS.-DOKLADY, VOL. 8, P. 205 (1963)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE B
3) THE SAMPLES WERE POSITIONED ON PLATES OF AL OR FE AS INDICATED IN COLUMN 6.
4) THE SPECIMENS WERE 3 TO 4 MM THICK AND 10 TO 15 MM IN DIAMETER.
5) THE PRESSURES WERE PRODUCED BY AN EXPLOSIVELY ACCELERATED ALUMINUM OR STEEL PLATE AS INDICATED IN COLUMN 6.
6) V0I WAS OBTAINED FROM A CUBIC LATTICE CONSTANT OF 3.3026 ANGSTROM AMERICAN INSTITUTE OF PHYSICS HANDBOOK (MCGRAW-HILL BOOK CO., N.Y., 1963) 2ND ED.
7) ALSO LISTED ARE: RHO0 AT 0 DEG. K. 16.18 G/CC
ELECTRONIC HEAT CAPACITY COEFFICIENT
325 ERGS/G DEG**2
GRUNEISEN CONSTANT = 1.68

TABLE I



56---4
TANTALUM

TA

VO = 0.06006 G/CC CL = 4.15 KM/SEC CO = 3.39 KM/CC
VOI = 0.06012 - CS = 2.07 - CB = 3.41 -

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

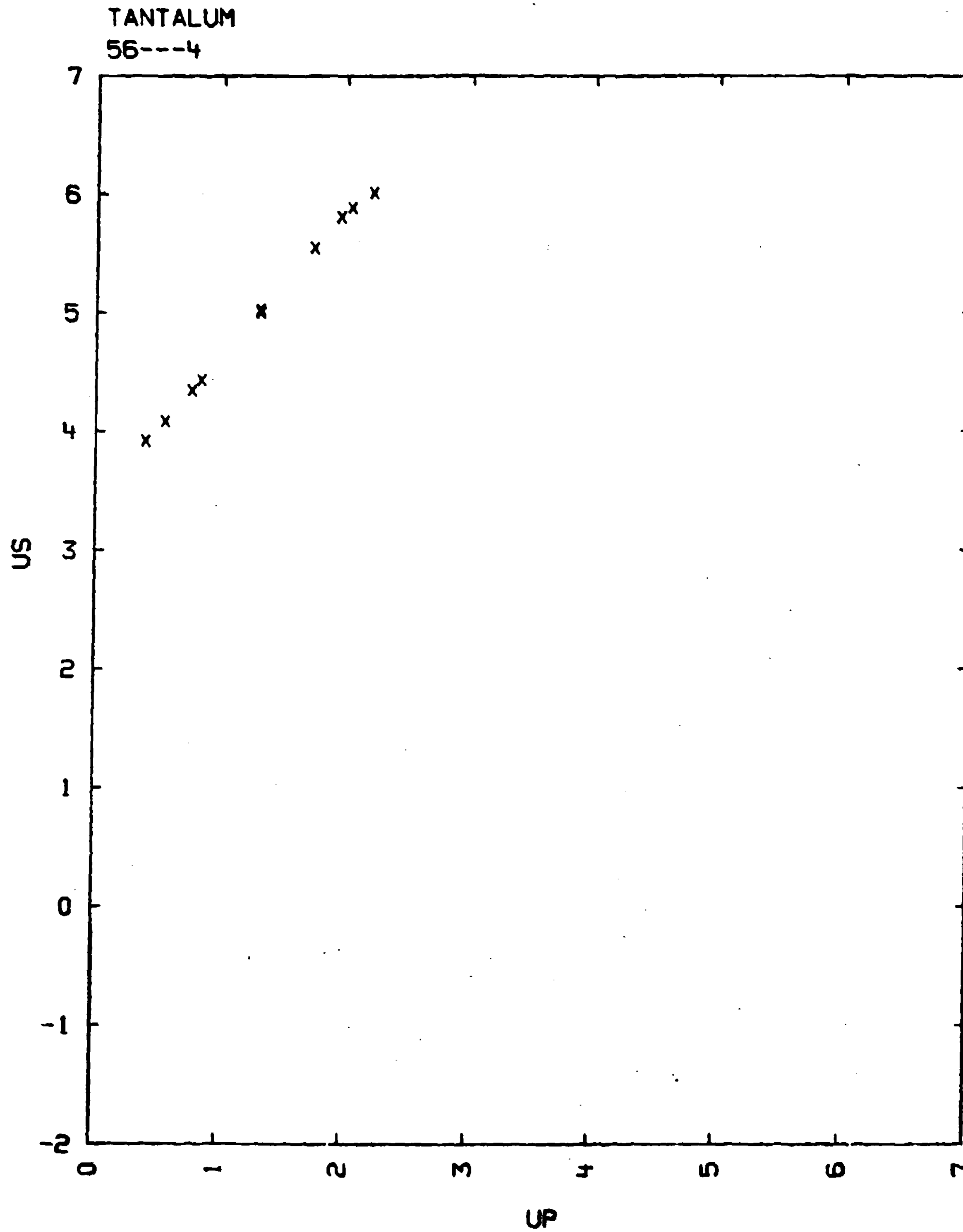
----------SAMPLE----------					-----STANDARD-----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
16.660	3.92	0.40	261.	0.8980	CU	4.70
16.640	4.07	0.55	372.	0.8649	CU	4.95
16.650	4.33	0.77	555.	0.8222	CU	5.35
16.660	4.43	0.84	620.	0.8104	CU	5.47
16.650	4.99	1.32	1097.	0.7355	CU	6.29
16.660	5.02	1.32	1104.	0.7371	CU	6.30
16.660	5.54	1.75	1615.	0.6841	CU	7.03
16.640	5.80	1.96	1892.	0.6621	CU	7.39
16.660	5.88	2.04	1998.	0.6531	CU	7.52
16.650	6.01	2.22	2221.	0.6306	CU	7.80

US = 3.414 + 1.200*UP KM/SEC
SIGMA US = 0.06 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES, HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII
2) EXPERIMENTAL TECHNIQUE: B
DATA REDUCTION METHOD : B
3) HUGONIOT ELASTIC LIMIT = 8 KBAR
4) VOI FROM WYCKOFF CRYSTAL STRUCTURES (JOHN WILEY AND SONS, N.Y. 1963) VOL. 1.
5) HUGONIOT ELASTIC LIMIT 18.7 KBAR

TABLE I



57---0
TITANIUM SUMMARY

TI

VO = 0.2217 - 0.2222 CC/G
VOI= 0.2183 CC/G   CB = 4.84 KM/SEC

THE TABLE LISTS HUGONIOT POINTS CALCULATED FROM THE FIT GIVEN BELOW.
UNITS ARE: G/CC, KM/SEC, KBAR AND KBAR.CC/G FOR THE ENERGY DIFFERENCE.

TABLE

RHOO	US	UP	P	V/VO	E-EO
4.51	5.382	0.6	146.	0.8885	1.8
-	5.841	1.0	263.	0.8288	5.0
-	6.897	2.0	630.	0.714	20.0
-	8.133	3.0	1100.	0.631	45.0
-	9.279	4.0	1674.	0.569	80.0
-	10.425	5.0	2351.	0.520	125.
-	11.571	6.0	3131.	0.481	180.

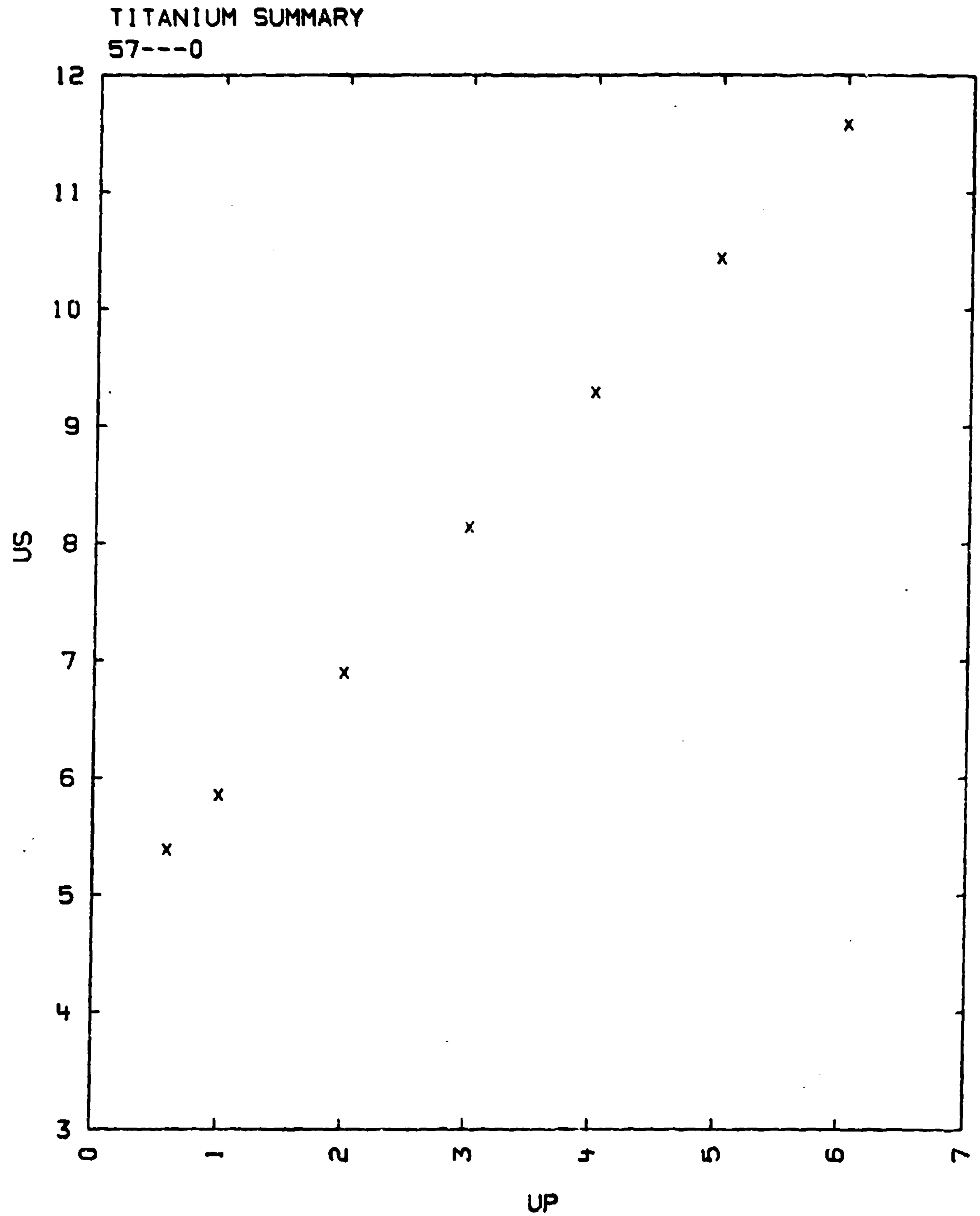
US = 4.695 + 1.146 UP, SIG.US = 0.10 KM/SEC
FOR UP BETWEEN .68 AND 5.6 KM/SEC.

COMMENTS:

1) SOURCE: COMPILER
1A) DATA FROM 57---1,2 AND 3 WERE USED FOR THIS FIT.
2) VOI AND CB WERE TAKEN FROM 57---2.

U06/14/77

TABLE I



57---1
TITANIUM

TI 99.75 PER CENT
AL 0.05 PER CENT
SI 0.05 PER CENT
CR 0.05 PER CENT
MN 0.05 PER CENT
SN 0.05 PER CENT

VO = 0.2217 CC/G.
VO' = 0.2183 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURE IN KILOBARS, AND DENSITY IN G/CC.

TABLE

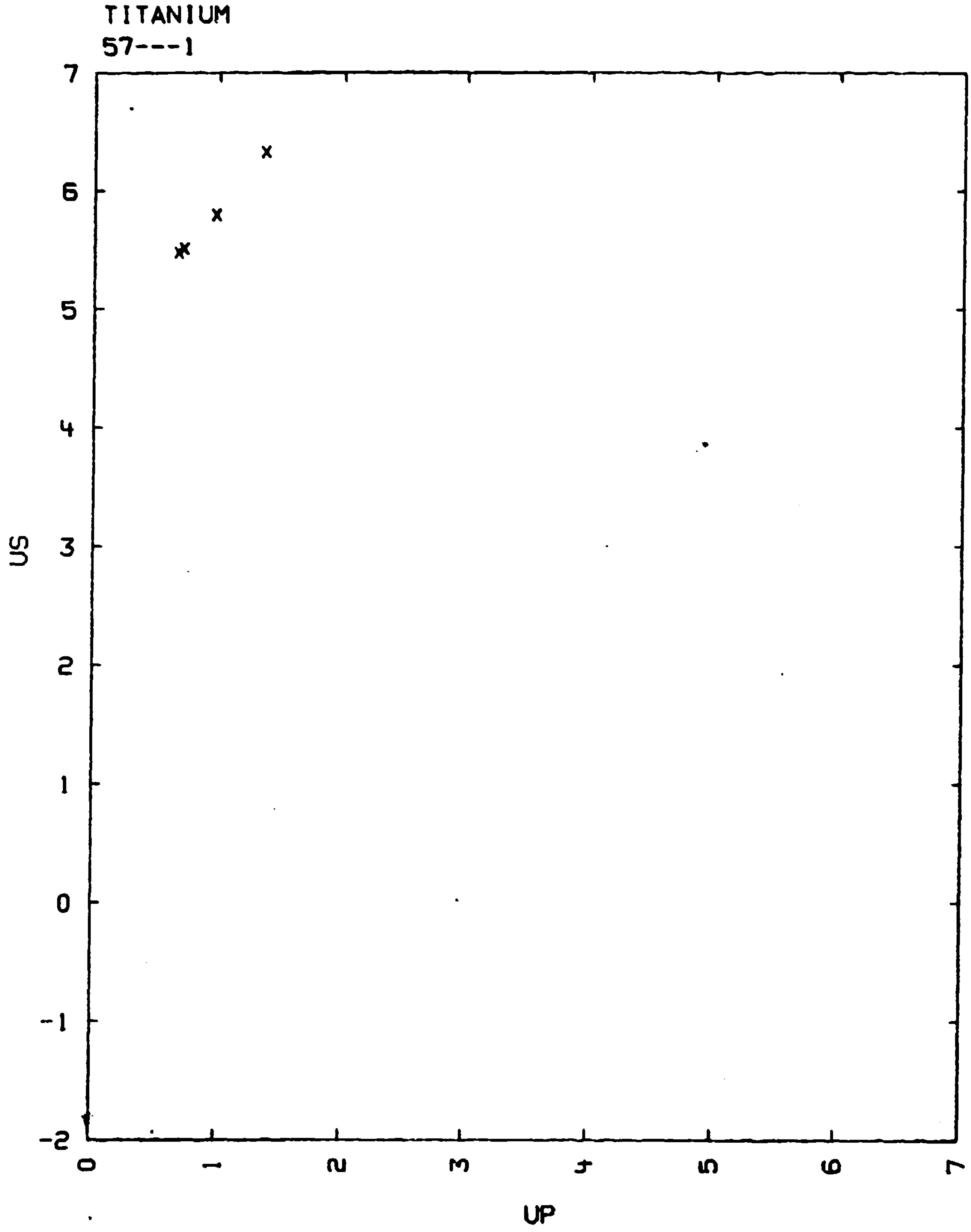
RHOO	US	UFS	UP	P	V/VO
4.51	6.329	2.723	1.370	390.8	0.7835
-	5.790	1.926	0.980	255.7	0.8307
-	5.501	1.437	0.723	179.3	0.8686
-	5.469	1.364	0.684	168.3	0.8749

US = 4.590 + 1.259 UP KM/SEC SIGMA US = 0.5 PERCENT

COMMENTS:

1) SOURCE: WALSH, J.M., RICE, M.H., MCQUEEN, R.G. AND YARGER, F.L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 1 PER CENT IN COMPRESSION AT A GIVEN PRESSURE.
4) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS

TABLE I



57---2
TITANIUM

TI

V0 = 0.2217 CC/G.　　　　　　　　CO = 4.84 KM/SEC.
V0I = 0.2183 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC.,
PRESSURES IN KILOBARS AND DENSITY IN G/CC.

TABLE

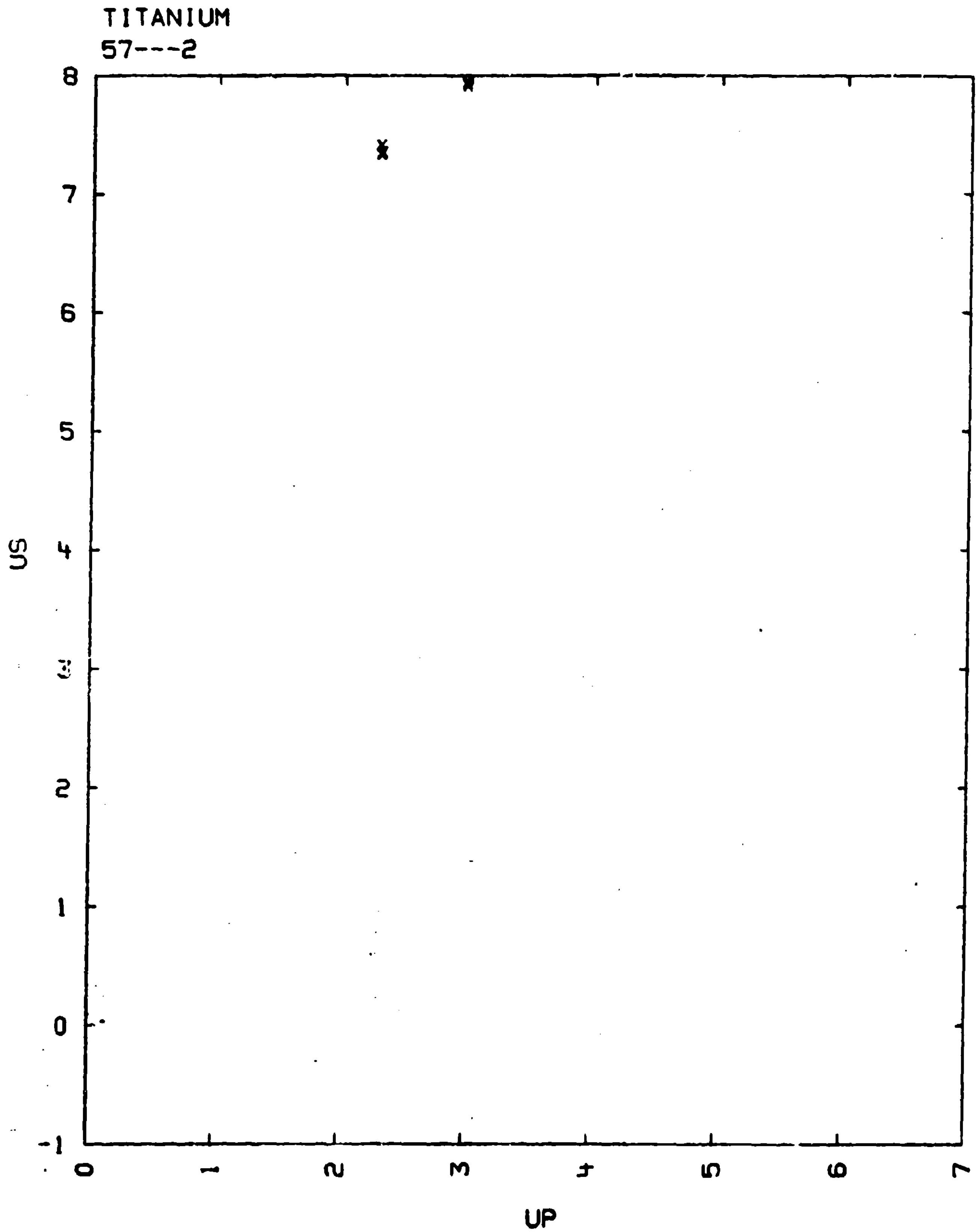
RHO0	US	UP	P	V/V0	PRESSURE IN BRASS STANDARD
4.51	7.35	2.30	762	0.687	1043
-	7.40	2.29	764	0.691	1040
-	7.34	2.29	758	0.689	1038
-	7.94	2.97	1063	0.626	1497
-	7.92	2.97	1060	0.625	1497

US = 4.779 + 1.089 UP KM/SEC.　　　SIGMA US = 0.74 PERCENT

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
J. APPL. PHYS., VOL. 31, P. 1253 (1960)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS BRASS
3) FOR THE BRASS STANDARD DATA SEE MATERIAL 36-33
4) V0I WAS TAKEN FROM THE A. I. P. HANDBOOK (MCGRAW HILL BOOK CO.)
2ND ED.

TABLE I



57---3
TITANIUM

TI

VO = 0.222 CC/G
VOI = 0.2183 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC. ST DESIGNATES THE STANDARD MATERIAL USED AS STRIKER PLATE. U(ST) IS THE VELOCITY BEFORE IMPACT.

TABLE

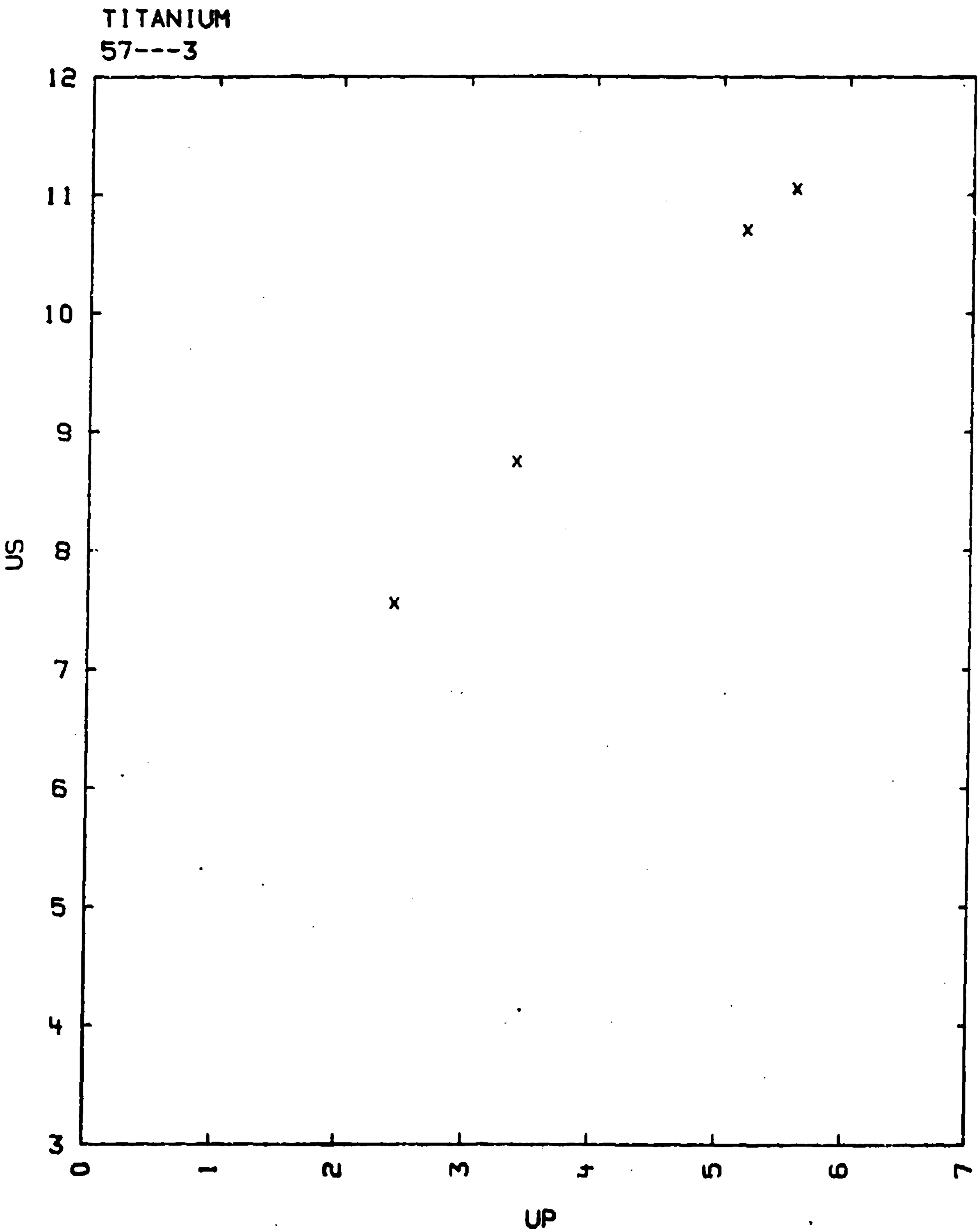
RHOO	US	UP	P	V/VO	ST	U(ST)
4.50	7.55	2.44	828	0.6768	AL	5.60
-	8.74	3.39	1331	0.6124	FE	5.60
-	10.70	5.19	2500	0.5155	FE	8.640
-	11.05	5.58	2775	4.4950	FE	9.10

US = 4.89 + 1.11 UP KM/SEC.   FOR UP BETWEEN 2.44 TO 5.59 KM/SEC.
SIGMA US = 0.08 KM/SEC.

COMMENTS:

1) SOURCE: KRUPNIKOV, K. K., BAKANOVA, A. A., BRAZHNIK, M. I. AND TRUNIN, R. F.
SOVIET PHYS.-JETP, VOL. 8, P. 205 (1963)
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE B
3) THE SAMPLES WERE POSITIONED ON PLATES OF AL OR FE AS INDICATED IN COLUMN 6.
4) THE SPECIMENS WERE 3 TO 4 MM THICK AND 10 TO 15 MM IN DIAMETER.
5) THE PRESSURES WERE PRODUCED BY AN EXPLOSIVELY ACCELERATED ALUMINUM OR STEEL PLATE AS INDICATED IN COLUMN 6.
6) VOI WAS OBTAINED FROM THE AMERICAN INSTITUTE OF PHYSICS HANDBOOK, (MCGRAW-HILL BOOK CO. 1957) 2ND ED.
7) ALSO LISTED ARE: RHOO AT 0 DEG. K. = 4.524 G/CC
ELECTRONIC HEAT CAPACITY COEFFICIENT
710 ERGS/G DEG**2
GRUNEISEN CONSTANT = 1.14

TABLE I



57---4
TITANIUM

TI

VO = 0.2203-0.2217 CC/G
VOI = 0.2220 CC/G

CB = 5.22 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
4.517	5.54	0.40	100.	0.9278	2024 AL	5.98
4.517	5.58	0.52	131.	0.9068	2024 AL	6.18
4.517	5.71	0.55	142.	0.9037	CU	4.62
4.539	5.68	0.57	147.	0.8996	2024 AL	6.26
4.517	5.71	0.63	162.	0.8897	CU	4.71
4.539	5.75	0.71	185.	0.8765	2024 AL	6.48
4.539	5.73	0.71	185.	0.8761	2024 AL	6.48
4.517	5.69	0.75	193.	0.8682	2024 AL	6.53
4.517	5.73	0.78	202.	0.8639	CU	4.88
4.539	5.95	1.00	270.	0.8319	2024 AL	6.91
4.539	5.89	1.01	270.	0.8285	2024 AL	6.91
4.517	5.87	1.03	273.	0.8245	921-T AL	6.76
4.517	6.09	1.16	319.	0.8095	CU	5.33
4.539	6.29	1.31	374.	0.7917	2024 AL	7.38
4.539	6.23	1.32	373.	0.788!	2024 AL	7.38
4.539	6.36	1.44	414.	0.7736	921-T AL	7.41
4.517	6.36	1.49	436.	0.7690	2024 AL	7.64
4.539	6.45	1.49	436.	0.7686	2024 AL	7.64
4.539	6.44	1.56	462.	0.7611	2024 AL	7.74
4.539	6.53	1.56	460.	0.7600	2024 AL	7.74
4.539	6.50	1.66	503.	0.7515	2024 AL	7.90
4.539	6.68	1.66	501.	0.7504	2024 AL	7.90
4.539	6.65	1.71	355.	0.8251	2024 AL	7.97
4.539	6.69	1.71	518.	0.7440	2024 AL	7.97
4.539	6.68	1.94	613.	0.7225	921-T AL	8.20
4.517	6.99	2.17	703.	0.6961	2024 AL	8.64
4.539	7.14	2.17	701.	0.6952	2024 AL	8.64
4.539	7.12	2.22	732.	0.6963	BRASS	6.42
4.510	7.31	2.23	729.	0.6924	BRASS	6.42
4.510	7.25	2.23	730.	0.6928	BRASS	6.43
4.510	7.26	2.28	749.	0.6864	921-T AL	8.72
4.517	7.27	2.60	881.	0.6538	2024 AL	9.24
4.510	7.51	2.75	970.	0.6461	2024 AL	9.50
4.539	7.77	2.76	982.	0.6406	2024 AL	9.50
4.539	7.68	2.85	1008.	0.6360	CU	7.35
4.517	7.83	2.89	1022.	0.6314	BRASS	7.18
4.510	7.84	2.89	1019.	0.6304	BRASS	7.18
4.510	7.82	3.15	1171.	0.6154	2024 AL	10.08
4.539	8.19					

TITANIUM

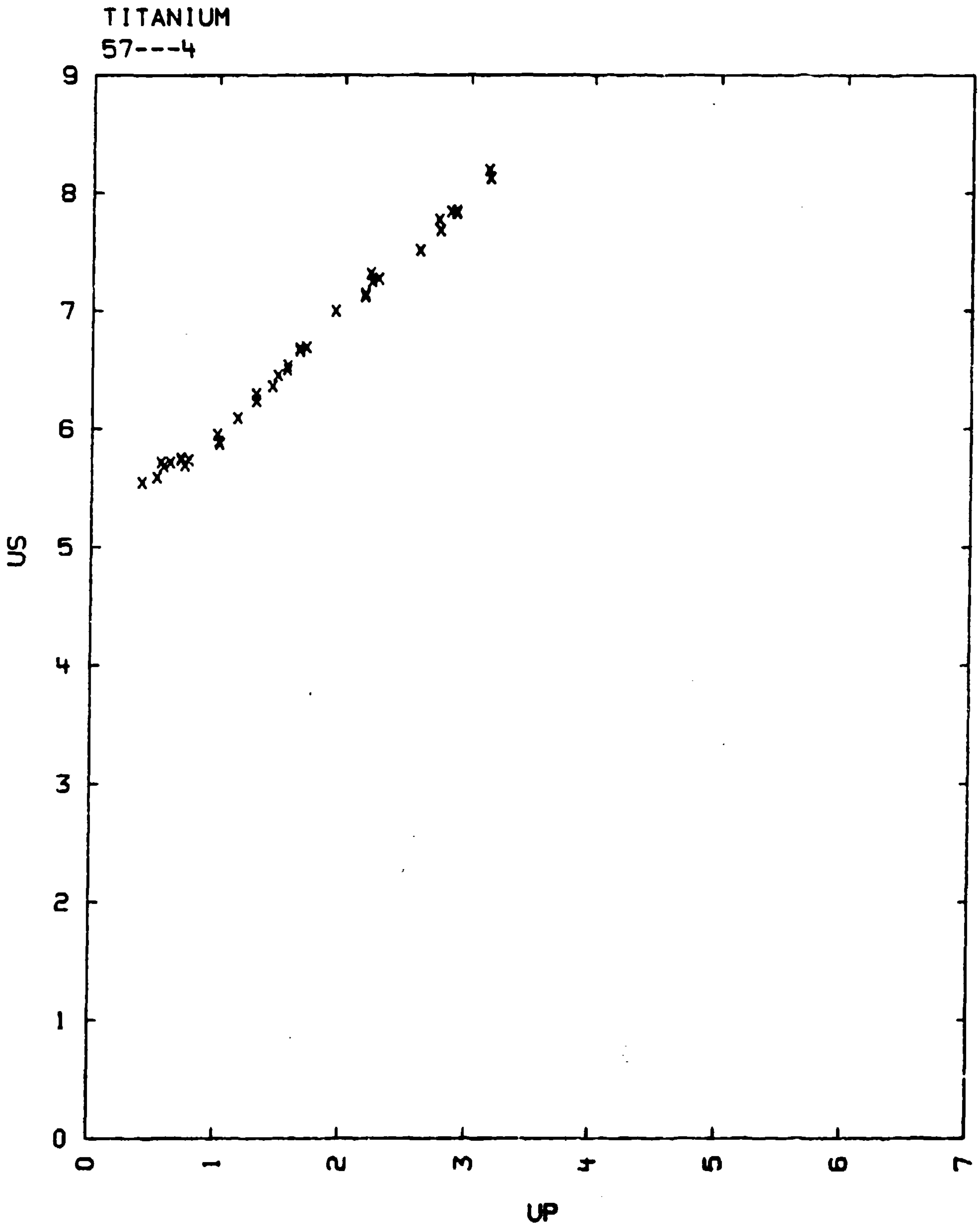
RHOO	US	UP	P	V/VO	MATERIAL US(ST)
4.539	8.12	3.16	1165.	0.6108	2024 AL 10.08

US = 5.220 + 0.767*UP KM/SEC KM/SEC FOR UP LESS THAN 0.72 AND USING CO
SIG US = 0.038 KM/SEC
US = 4.889 + 1.045*UP KM/SEC
SIG US = 0.068 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES.
HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII
2) EXPERIMENTAL TECHNIQUE: B
DATA REDUCTION TECHNIQUE: B
3) VOI FROM WYCKOFF, CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, N.Y. (1963) V. 1
4) SAMPLES WERE STRONGLY ANISOTROPIC, SUGGESTING THAT THE ISOTROPY ASSUMPTION IN CALCULATING CO IS POOR.
5) TRANSITION AT 175 KBAR PROBABLY FCC-BCC
6) HUGONIOT ELASTIC LIMIT 18.5 KBAR

TABLE I



57---5
TITANIUM

TI	99.6	WT. PERCENT
FE	0.25	- -
C	0.02	- -
N	0.01	- -
O	0.115-0.123	- -

VO = 0.2218 CC/G   CL = 6.118 KM/SEC   CO = 4.83 KM/SEC
VOI= 0.2220 -   CS = 3.246 -

THE TABLE LISTS RHOO IN G/CC, VELOCITIES IN KM/SEC AND P IN KBARS.
TI = TITANIUM, FS= FANSTEEL AND WF= WEIGHTING FACTOR.

TABLE

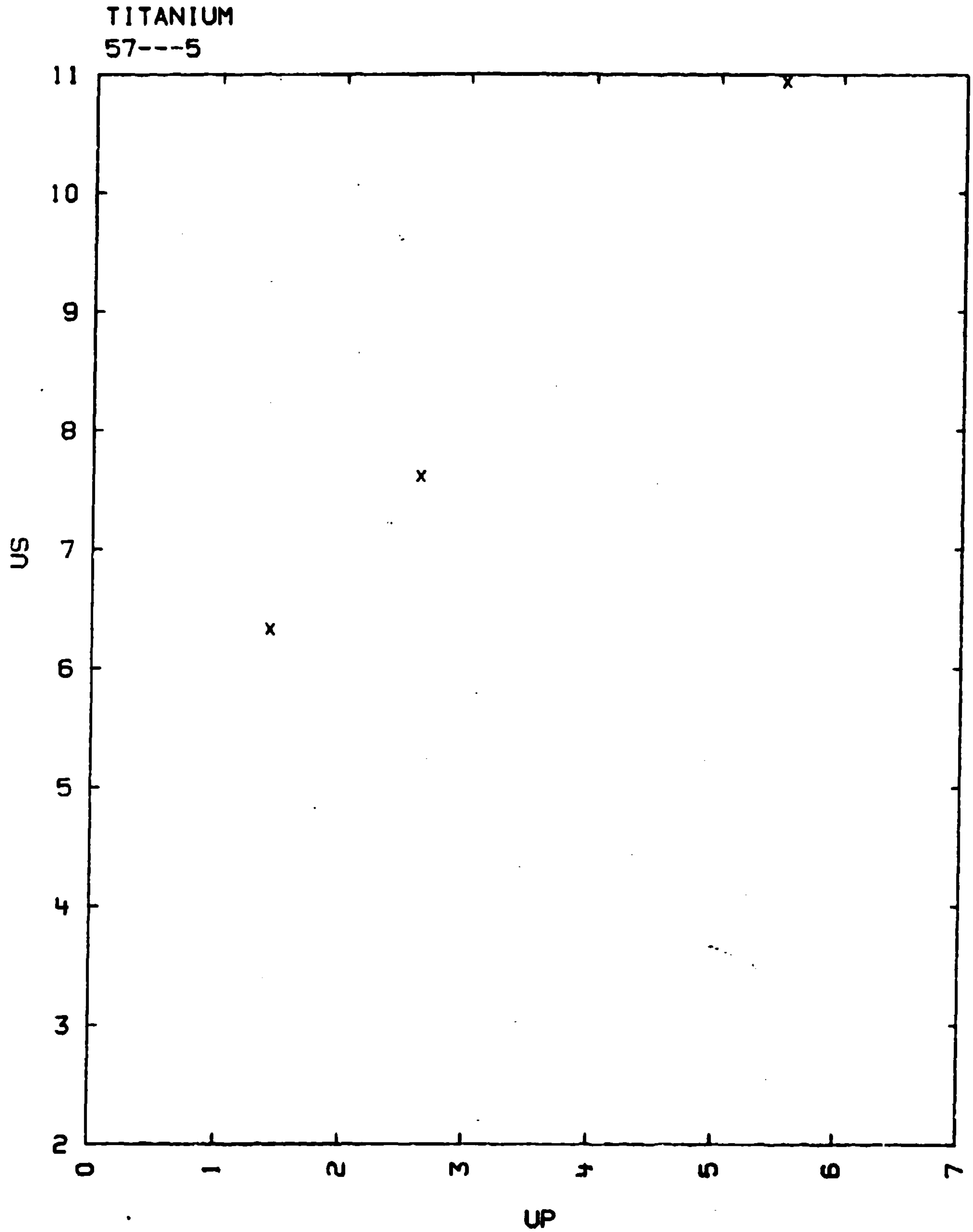
SAMPLE					IMPACTOR		
RHOO	US	UP	P	V/VO	MAT	U	WF
4.508	6.321	1.422	405.	.7750	TI	2.845	1
4.508	7.604	2.621	899.	.6553	TI	5.242	1
4.508	10.939	5.534	2728.	.4939	FS	7.849	1

US = 4.695 + 1.146*UP KM/SEC
SIG.US = 0.045 KM/SEC.

COMMENTS:

1) SOURCE: ISBELL W.M., SHIPMAN F.H. AND JONES A.H.
HUGONIOT EQUATION OF STATE OF ELEVEN MATERIALS TO FIVE MBARS
MATERIALS SCIENCE LABORATORY REPORT: MSL-68-13
2) EXPERIMENTAL TECHNIQUE: A
DATA REDUCTION METHOD : A
3) NOMINAL UNCERTAINTIES ARE: (SIG.US)/US = .005 AND (SIG.U)/U = .0005
4) ALSO LISTED ARE: POISSONS RATIO= 0.304, YIELD STRENGTH = 3.4-3.8 KBAR
TENSILE - = 5.2-5.3 KBAR
5) VOI OBTAINED FROM WYCKOFF CRYSTAL STRUCTURES
(JOHN WILEY AND SONS, N.Y. 1963) VOL. 1

TABLE I



58---1
ZIRCONIUM

ZR 99.8 PER CENT OR GREATER

VO = 0.1540 CC/G.
VO1 = 0.1545 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURE IN KILOBARS, AND DENSITY IN G/CC.

TABLE

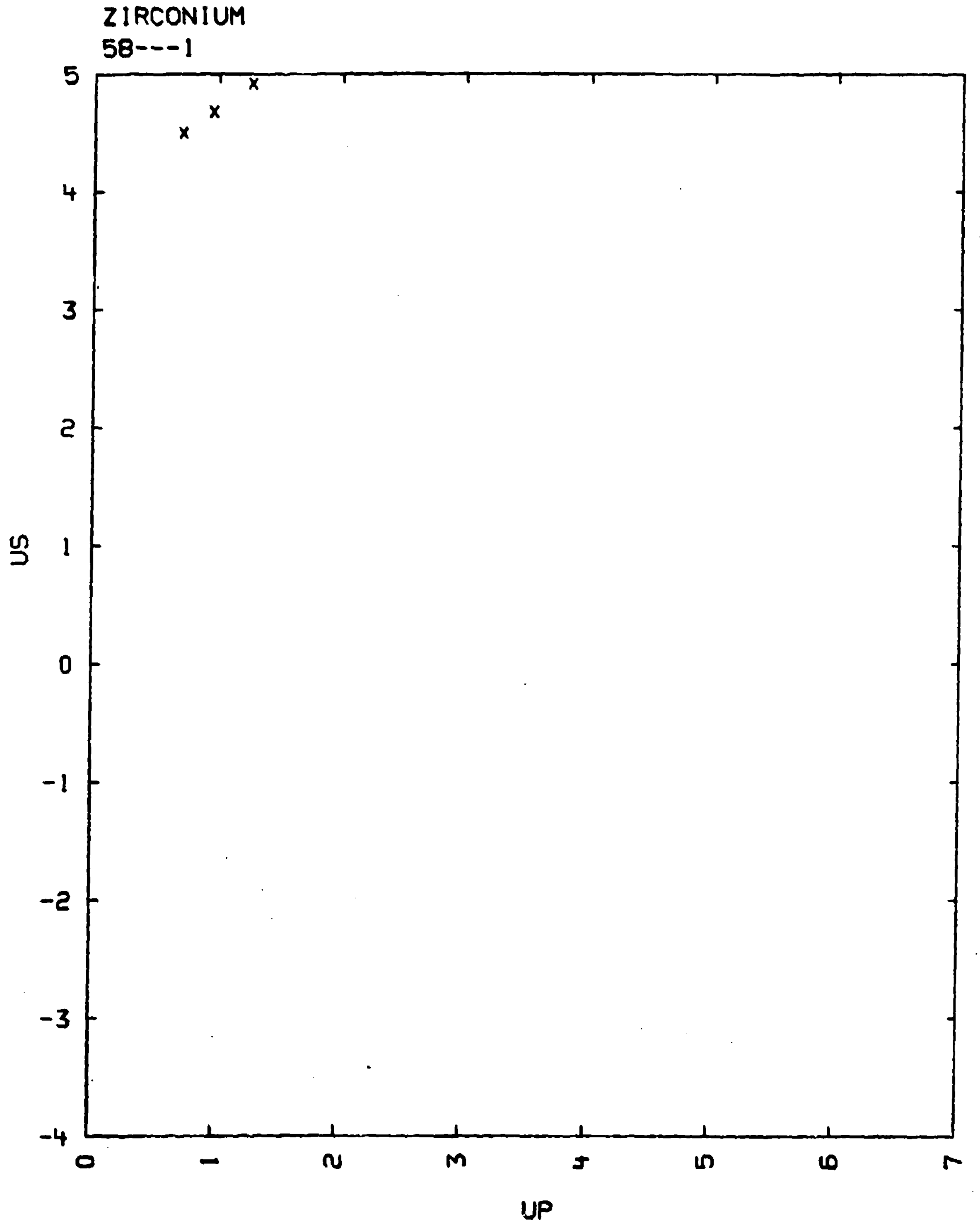
RHOO	US	UP	P	V1V0
6.49	4.494	0.7117	207.5	0.8416
-	4.674	0.9563	290	0.7954
-	4.920	1.275	407	0.7408

US = 3.953 + 0.7570 UP KM/SEC   SIGMA US = 0.1 PERCENT

COMMENTS:

1) SOURCE: WALSH, J. M., RICE, M. H., MCQUEEN, R. C. AND YARGER, F. L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 3 PER CENT IN COMPRESSION AT A GIVEN PRESSURE.
4) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS.

TABLE I



58---2
ZIRCONIUM

ZR 99.5 PERCENT OR GREATER

VO = 0.1537 CC/G. CL = 4.76 KM/SEC. CO = 3.88 KM/SEC.
VOI = 0.1542 CC/G. CS = 2.39 KM/SEC. CB = 3.74 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC.,
PRESSURE IN KILOBARS AND DENSITIES IN G/CC.

TABLE

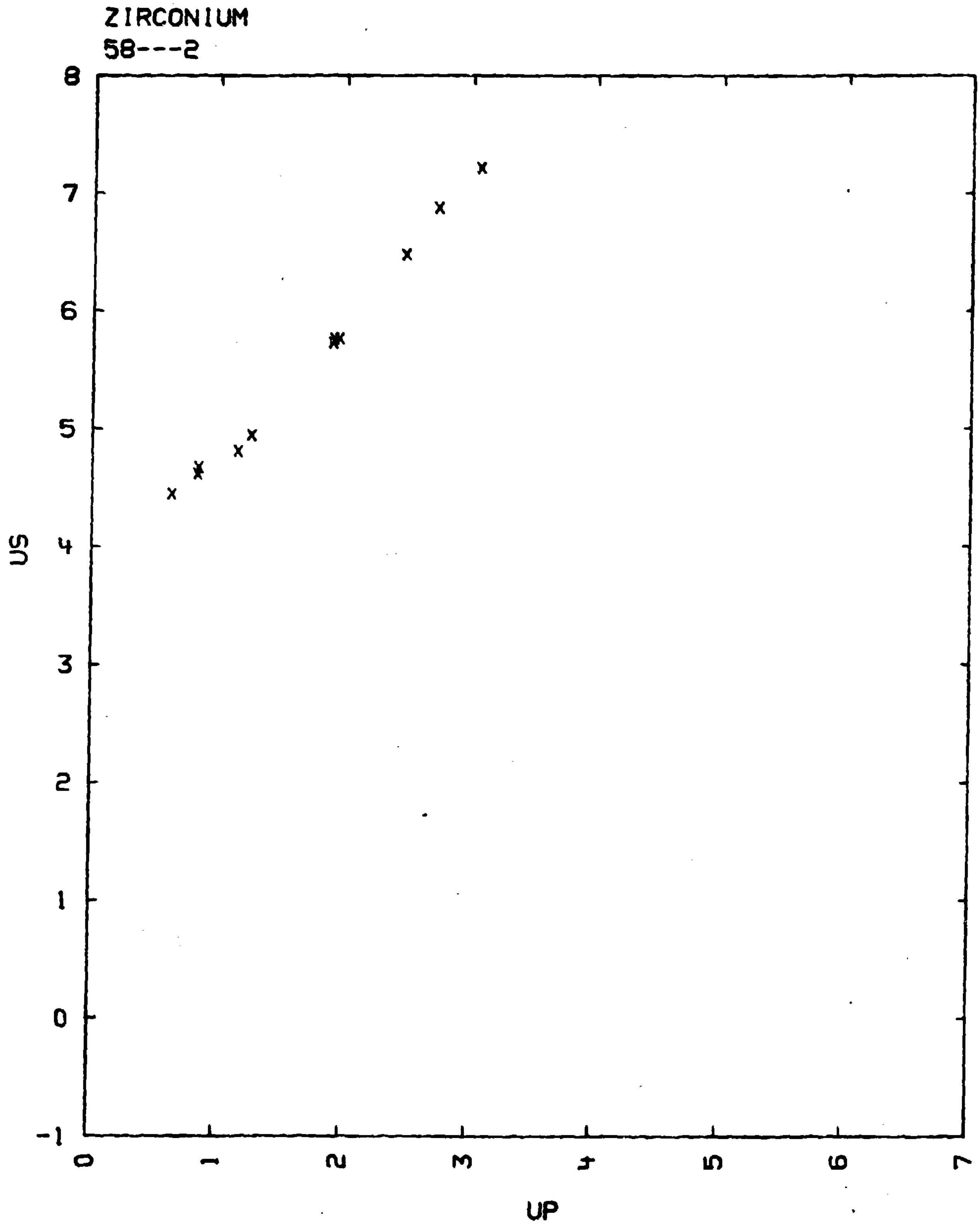
SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	RHOO	US
6.506	4.440	0.634	183.1	0.8572	8.932	4.764
6.506	4.609	0.841	252.2	0.8175	8.934	5.024
6.509	4.661	0.850	257.9	0.8176	-	5.040
6.503	4.804	1.168	364.9	0.7569	-	5.426
6.505	4.938	1.267	407.0	0.7434	-	5.554
6.505	5.720	1.911	711.1	0.6659	-	6.387
6.512	5.758	1.917	718.8	0.6671	-	6.400
6.505	5.753	1.956	732.0	0.6600	-	6.443
6.506	6.467	2.476	1041.8	0.6171	-	7.133
6.506	6.867	2.732	1220.6	0.6022	-	7.482
6.505	7.211	3.065	1437.7	0.5750	-	7.910

US = 3.812 + 0.9767 UP KM/SEC. FOR BELOW 257.9 KILOBARS
US = 3.287 + 1.287 UP KM/SEC. FOR 364.9 KILOBARS AND ABOVE

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
REPORT NO.: GMX-6-566, PP. 51-62 (1964)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS COPPER
3) THE COPPER HUGONIOT IS REPRESENTED BY
US = 3.958 + 1.497 UP KM/SEC.
THE PARTIAL (DE/DP)V = 0.0562 CUBIC CM.
4) A TRANSITION APPEARS BETWEEN 257.9 AND 364.9 KILOBARS
5) VOI WAS TAKEN FROM THE AMERICAN INSTITUTE OF PHYS. HANDBOOK (MCGRAW-HILL BOOK CO. N.Y., 1963) 2ND ED.

TABLE I



58---3
ZIRCONIUM

ZR

VO = 0.1536-0.1541 CC/G   CL = 4.77 KM/SEC   CO = 3.89 KM/SEC
VOI = 0.1537 CC/G   CS = 2.39 KM/SEC   CB = 3.74 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

----SAMPLE----					----STANDARD----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
6.510	4.34	0.53	150.	0.8779	CU	4.61
6.510	4.28	0.54	150.	0.8738	CU	4.62
6.506	4.38	0.60	171.	0.8630	CU	4.70
6.510	4.38	0.61	174.	0.8607	CU	4.71
6.488	4.44	0.68	196.	0.8468	2024 AL	6.49
6.510	4.51	0.74	217.	0.8359	CU	4.87
6.510	4.52	0.74	218.	0.8363	CU	4.88
6.506	4.54	0.80	236.	0.8238	CU	4.95
6.509	4.59	0.81	242.	0.8235	CU	4.97
6.488	4.62	0.93	279.	0.7987	2024 AL	6.88
6.510	4.73	1.11	342.	0.7653	CU	5.33
6.503	4.73	1.13	348.	0.7611	CU	5.35
6.510	4.86	1.21	383.	0.7510	CU	5.45
6.505	4.87	1.22	386.	0.7495	CU	5.47
6.488	4.86	1.24	391.	0.7449	2024 AL	7.38
6.505	5.64	1.86	682.	0.6702	CU	6.29
6.512	5.67	1.87	690.	0.6702	CU	6.31
6.505	5.67	1.91	704.	0.6631	CU	6.35
6.509	5.97	2.10	816.	0.6482	CU	6.62
6.510	6.11	2.23	887.	0.6350	CU	6.77
6.506	6.37	2.42	1003.	0.6201	CU	7.03
6.510	6.52	2.57	1091.	0.6058	CU	7.22
6.510	6.73	2.66	1165.	0.6048	CU	7.35
6.506	6.77	2.68	1180.	0.6041	CU	7.37
6.505	7.11	3.01	1392.	0.5767	CU	7.80

US = 3.757 + 1.018*UP KM/SEC FOR UP LESS THAN 0.8 KM/SEC
SIGMA US = 0.023 KM/SEC
US = 3.411 + 1.222*UP KM/SEC FOR UP ABOVE 1.0 KM/SEC
SIGMA US = 0.07 KM/SEC

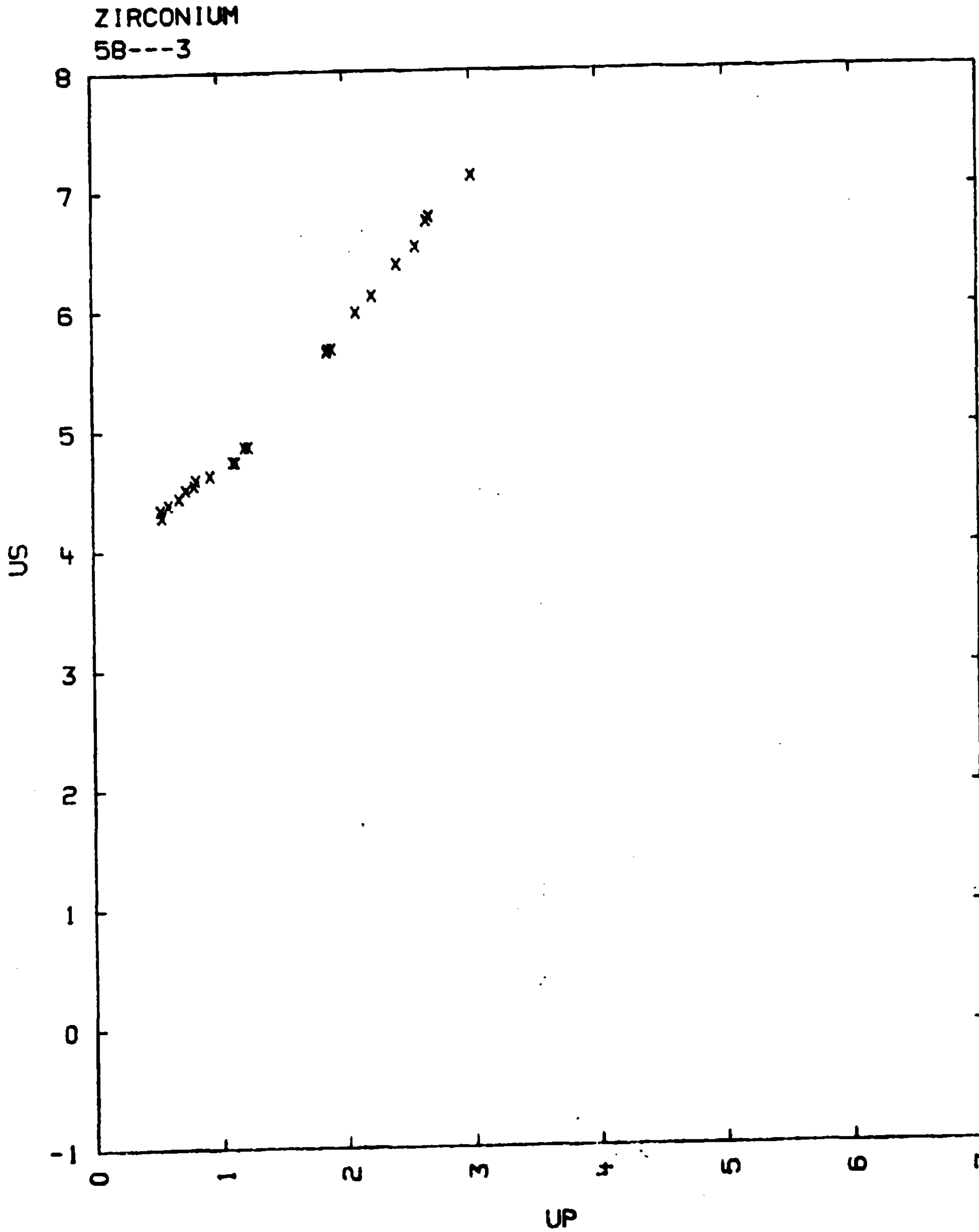
COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.N., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES,

HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII

2) EXPERIMENTAL TECHNIQUE: B
   DATA REDUCTION TECHNIQUE: B
3) V0I FROM WYCKOFF, CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, N.Y. (1963) V. 1
4) TRANSITION AT 260 KBAR PROBABLY FCC-BCC
5) V(DP/DE) = 1.09

TABLE I



58---4
ZIRCONIUM

ZR

VO = 0.154 CC/G   CO = 3.70
VOI = 0.1537 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

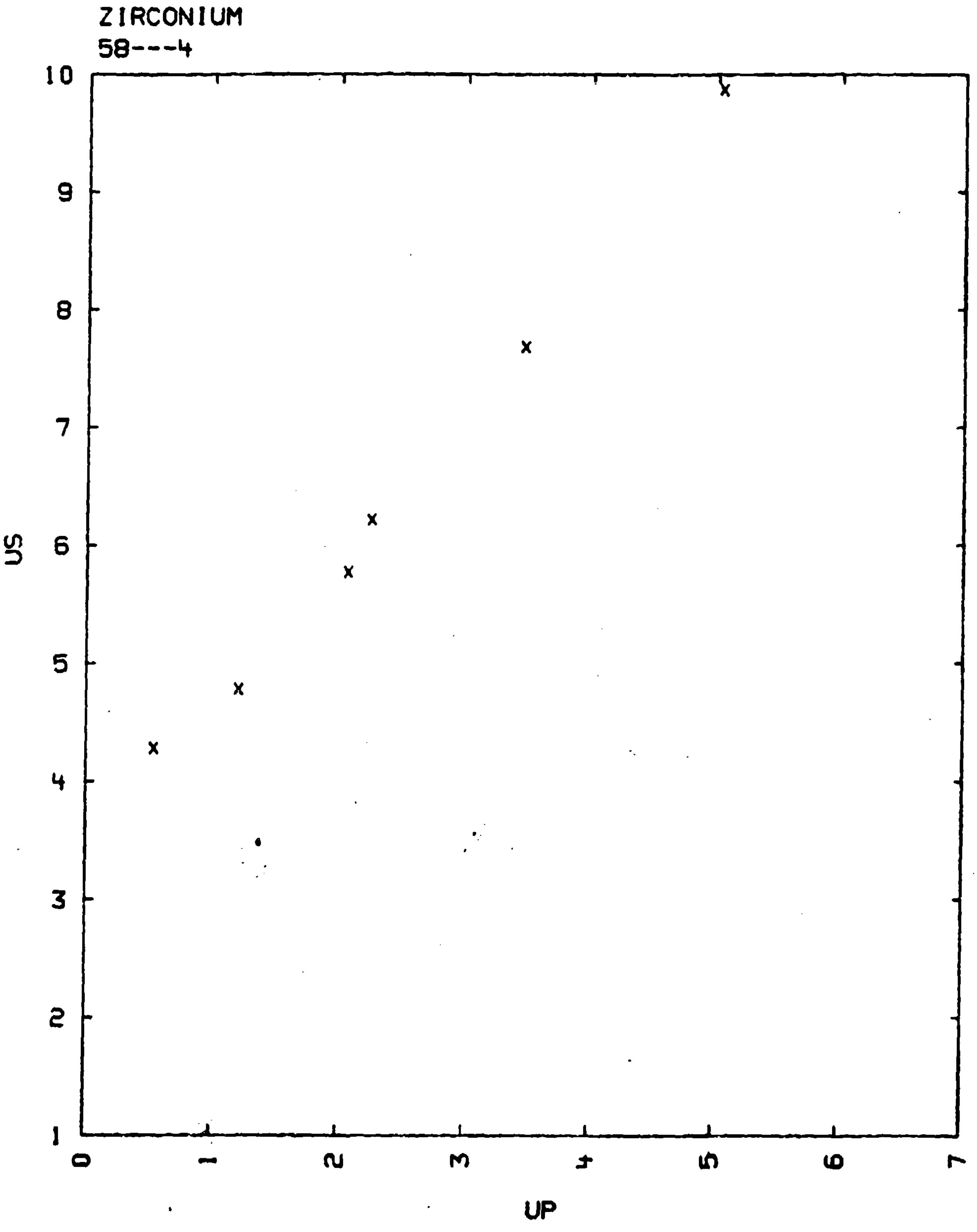
SAMPE					STANDARD		
RHOO	US	UP	P	V/VO	MATERIAL	RHOO(ST)	US(ST)
6.51	9.87	5.04	3238.	0.489	IRON	7.85	11.21
-	7.68	3.47	1735.	0.548	IRON	7.85	8.83
-	6.21	2.26	913.	0.636	ALUMINUM	2.71	9.17
-	5.77	2.08	782.	0.639			
-	4.78	1.22	380.	0.745	ALUMINUM	2.71	7.34
-	4.28	0.54	150.	0.874	ALUMINUM	2.71	6.21

US = 3.79 + 0.877*UP KM/SEC FOR UP BELOW 1.58 KM/SEC
US = 3.05 + 1.344*UP KM/SEC FOR UP BETWEEN 1.58 AND 5.04 KM/SEC

COMMENTS:

1) SOURCE: ALTSHULER, L. V., BAKANOVA, A. A., DUDOLADOV, I. P.
ZHURNAL EKSP- TEORET. FIZIKI V. 53, P. 1967 (1967).
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) ONLY SHOCK VELOCITIES WERE MEASURED TO DETERMINE THE STRESS STATES. THE UNCERTAINTY IN THE SHOCK VELOCITIES WAS ESTIMATED TO BE 1.0 PERCENT.
4) HUGONIOTS OF STANDARD MATERIALS USED WERE AS FOLLOWS
ALUMINUM US = 5.25 + 1.39*UP FOR UP BETWEEN 0.0 AND 6.0 KM/SEC
IRON US = 3.85 + 1.615*UP FOR UP BETWEEN 1.0 AND 4.6 KM/SEC
5) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF THE HEXAGONAL CLOSE-PACKED STRUCTURE,
A = 3.232 ANGSTROMS, C = 5.147 ANGSTROMS (25 DEG. C)
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SIDNEY, 1963) 2ND EDITION, VOL. 1, P. 11.
6) THE AUTHORS OBTAINED THE VALUE OF CO FROM HANDBOOK OF RARE METALS, (MIR PUBLISHERS, USSR, 1963) OR FROM C. KITTEL, INTRODUCTION TO SOLID STATE PHYSICS (FIZMATGIZ, USSR, 1963).
7) THE DISCONTINUITY OF THE US VS. UP PLOT AT UP = 1.58 KM/SEC IS ATTRIBUTED TO AN ELECTRONIC PHASE CHANGE.

TABLE I



59---1
HAFNIUM

HF 97 WT PERCENT
ZR 3 WT PERCENT

VO = 0.07792 CC/G   CL = 3.87 KM/SEC   CO = 3.03 KM/SEC
VOI = 0.075515 CC/G   CS = 2.08 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

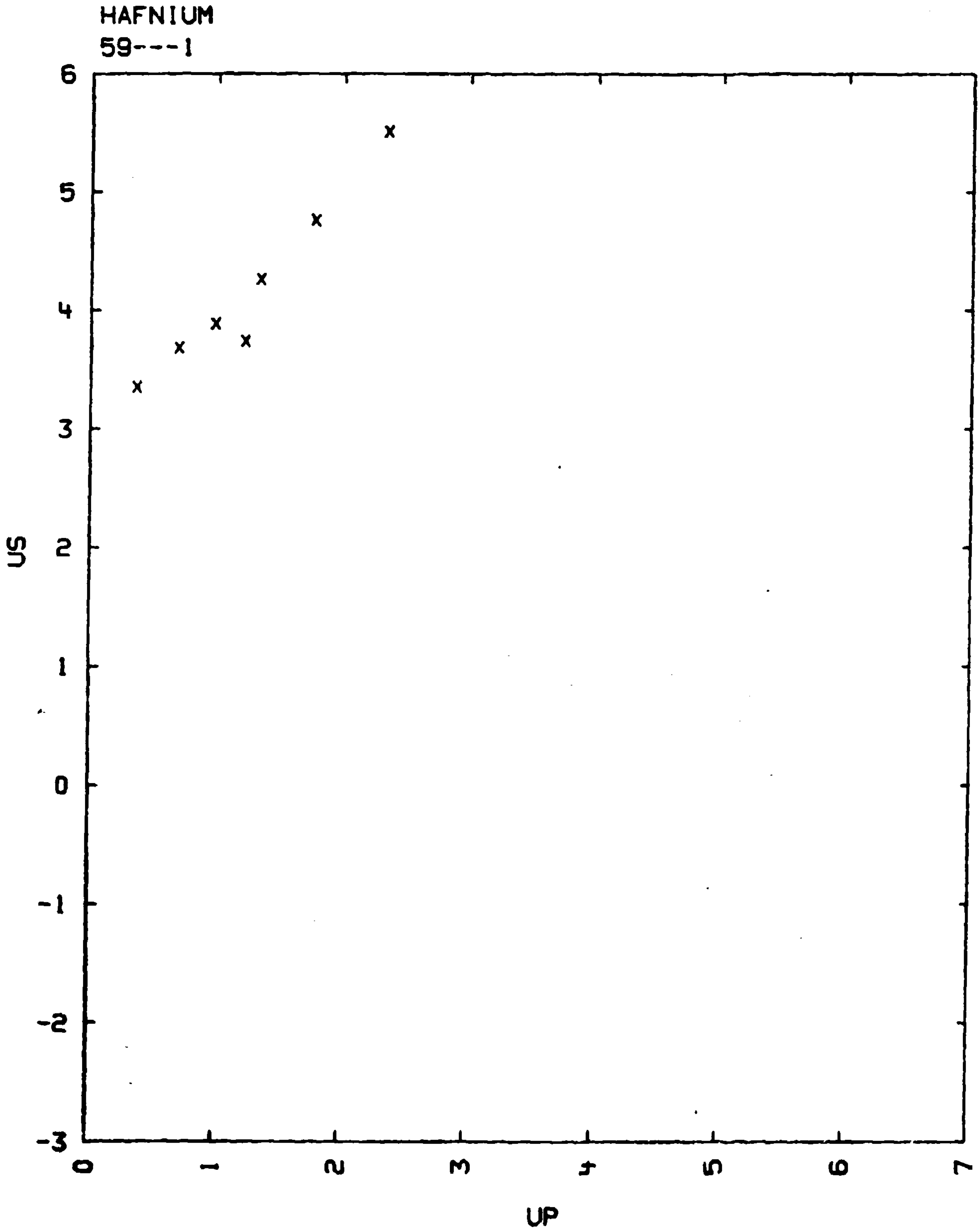
SAMPLE						STANDARD	
RHOO	US	UFS	UP	P	V/VO	MATERIAL	P
12.843	3.35	0.64	0.37	158	0.891	BRASS	148
12.848	3.73	2.33	1.23	590	0.670	BRASS	597
12.846	5.51	4.76	2.36	1667	0.573	BRASS	1543
12.830	3.68	1.51	0.70	332	0.809	ALUMINUM	221
12.824	4.26	2.91	1.35	738	0.683	ALUMINUM	472
12.828	4.76	3.61	1.78	1082	0.627	ALUMINUM	688
12.822	3.88	1.91	0.99	491	0.746	BRASS	462

US =

COMMENTS:

1) SOURCE: GUST, W. H.
PRIVATE COMMUNICATION
UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY, BOX 808, LIVERMORE, CALIFORNIA. 94550
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B.
3) THIS IS PRELIMINARY DATA AND FURTHER WORK IS IN PROGRESS. TAKING INTO ACCOUNT THE ACCURACY OF THE EXPERIMENTAL TECHNIQUE, THE DATA ARE BEST DESCRIBED BY MORE THAN ONE STRAIGHT LINE IN THE US VS. UP PLANE. THE SIGNIFICANCE OF THIS CHARACTERISTIC IS BEING INVESTIGATED.
4) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF THE HEXAGONAL CLOSE-PACKED STRUCTURE,
A = 3.1967 ANGSTROMS, C = 5.0578 ANGSTROMS (26 DEG. C.)
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SYDNEY, 1963) 2ND EDITION, VOL. 1, P. 11.
5) SOUND VELOCITIES WERE MEASURED BY H. L. DUNEGAN (SUPPORT ENGINEERING, ULTRASONIC GROUP) UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY, BOX 808, LIVERMORE, CALIFORNIA. 94550

TABLE I



59---2
HAFNIUM

HF

VO = 0.0775 CC/G CL = 3.86 KM/SEC CO = 2.98 KM/SEC
VOI = 0.07551 CC/G CS = 2.12 KM/SEC CB = 2.91 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
12.870	3.34	0.32	138.	0.9042	CU	4.44
12.900	3.43	0.44	195.	0.8717	CU	4.62
12.890	3.50	0.50	226.	0.8571	CU	4.71
12.900	3.53	0.50	228.	0.8584	CU	4.72
12.890	3.62	0.61	285.	0.8315	CU	4.88
12.880	3.86	0.92	457.	0.7617	CU	5.33
12.900	3.90	0.98	493.	0.7487	CU	5.42
12.900	3.90	1.00	503.	0.7436	CU	5.45
12.890	3.85	1.02	506.	0.7351	CU	5.47
12.900	3.96	1.02	521.	0.7424	CU	5.49
12.890	4.25	1.40	767.	0.6706	CU	6.04
12.830	4.46	1.55	887.	0.6525	CU	6.27
12.890	4.51	1.61	936.	0.6430	CU	6.36
12.910	4.65	1.69	1015.	0.6368	CU	6.49
12.900	4.74	1.77	1082.	0.6266	CU	6.62
12.840	4.88	1.88	1178.	0.6148	CU	6.77
12.920	5.21	2.17	1461.	0.5835	CU	7.22
12.890	5.44	2.23	1564.	0.5901	CU	7.35
12.910	5.42	2.25	1574.	0.5849	CU	7.37
12.890	5.52	2.42	1722.	0.5616	CU	7.61

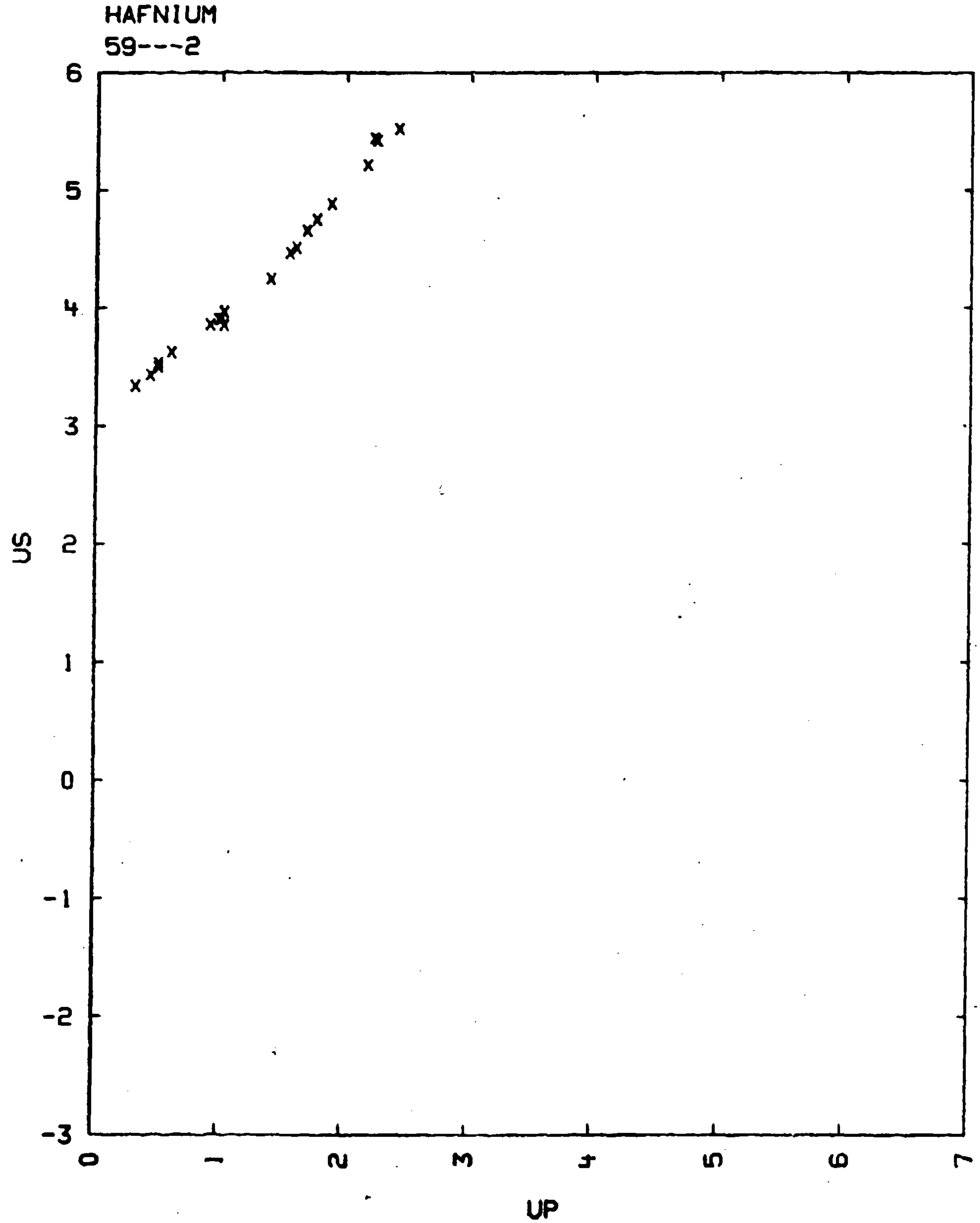
US = 2.954 + 1.121*UP KM/SEC BELOW UP = 0.8
SIGMA US = 0.021 KM/SEC
US = 2.421 + 1.311*UP KM/SEC FOR UP ABOVE 182 KM/SEC
SIGMA US = 0.051 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES, HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII
2) EXPERIMENTAL TECHNIQUE: B
DATA REDUCTION TECHNIQUE: B
3) VOI FROM WYCKOFF, CRYSTAL STRUCTURES (JOHN WILEY & SONS, N.Y., 1963)

V.I
4) TRANSITION AT 400 KBAR PROBABLY FCC-BCC
5) V(DP/DE) = 0.98

TABLE I



60---1
SCANDIUM

SC

VO = 0.3320 CC/G CL = 5.69 KM/SEC CO = 4.28 KM/SEC
VOI = 0.33494 CC/G CS = 3.25 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

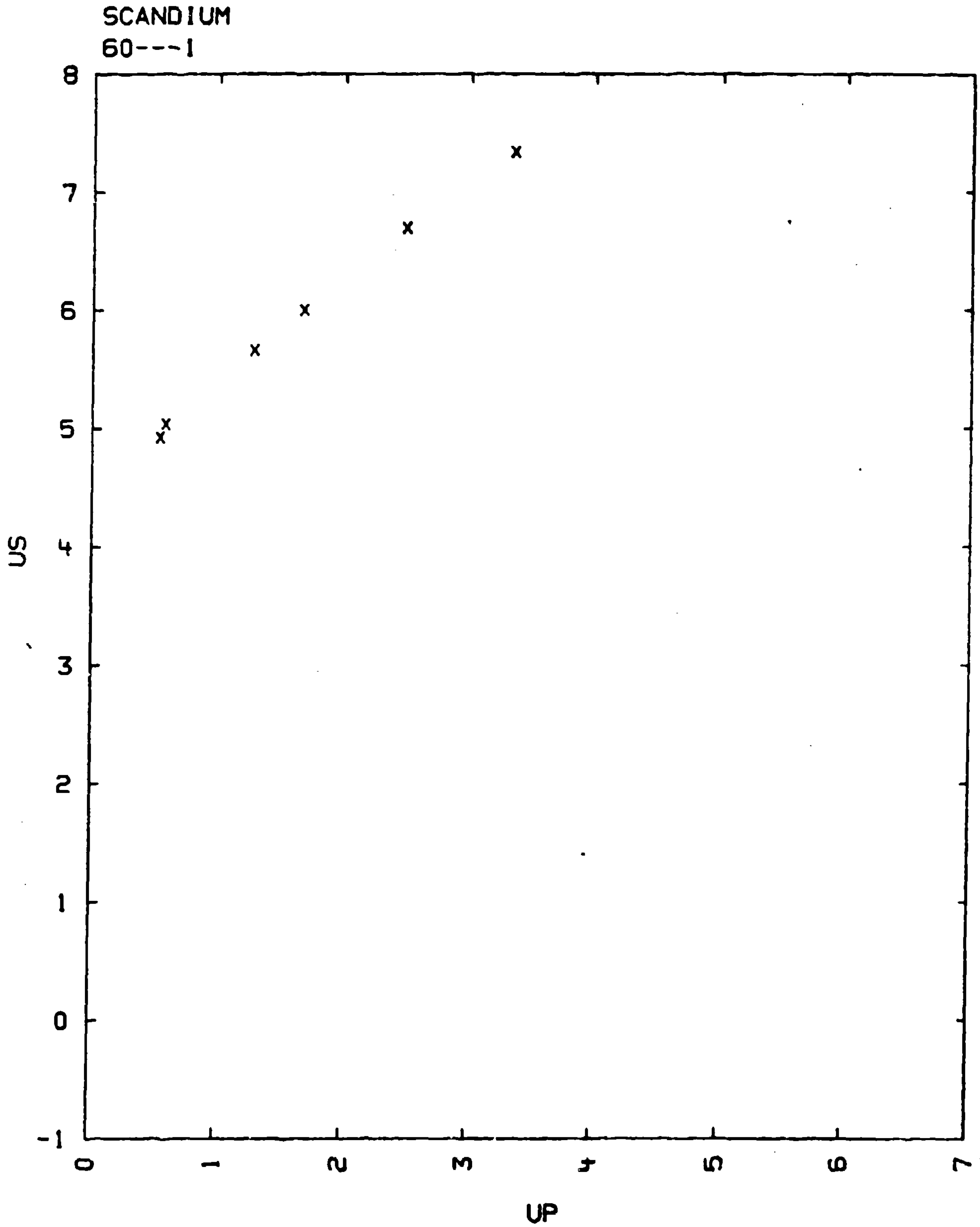
SAMPLE						STANDARD	
RHOO	US	UFS	UP	P	V/VO	MATERIAL	P
3.004	5.03	0.96	0.58	87	0.885	BRASS	147
3.010	5.99	3.10	1.68	301	0.720	BRASS	565
3.022	5.65	2.49	1.29	221	0.771	ALUMINUM	238
3.001	7.34	6.67	3.36	744	0.544	BRASS	1480
3.035	6.69	5.06	2.50	508	0.628	ALUMINUM	556
2.996	4.92	0.98	0.54	79	0.891	ALUMINUM	85

US =

COMMENTS:

1) SOURCE: GUST, W. H.
PRIVATE COMMUNICATION
UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY,
BOX 808, LIVERMORE, CALIFORNIA. 94550
2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION TECHNIQUE B.
3) THIS IS PRELIMINARY DATA AND FURTHER WORK IS IN PROGRESS. TAKING INTO ACCOUNT THE ACCURACY OF THE EXPERIMENTAL TECHNIQUE, THE DATA ARE BEST DESCRIBED BY MORE THAN ONE STRAIGHT LINE IN THE US VS. UP PLANE. THE SIGNIFICANCE OF THIS CHARACTERISTIC IS BEING INVESTIGATED.
4) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF THE HEXAGONAL CLOSE-PACKED STRUCTURE,
A = 3.3090 ANGSTROMS, C = 5.2733 ANGSTROMS (CA. 20 DEG. C.)
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SYDNEY, 1963) 2ND EDITION, VOL. 1, P. 11.
5) SOUND VELOCITIES WERE MEASURED BY H. L. DUNEGAN (SUPPORT ENGINEERING, ULTRASONIC GROUP) UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY, BOX 808, LIVERMORE, CALIFORNIA. 94550

TABLE I



60---2
SCANDIUM

SC

VO = 0.324 CC/G
VOI = 0.33494 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

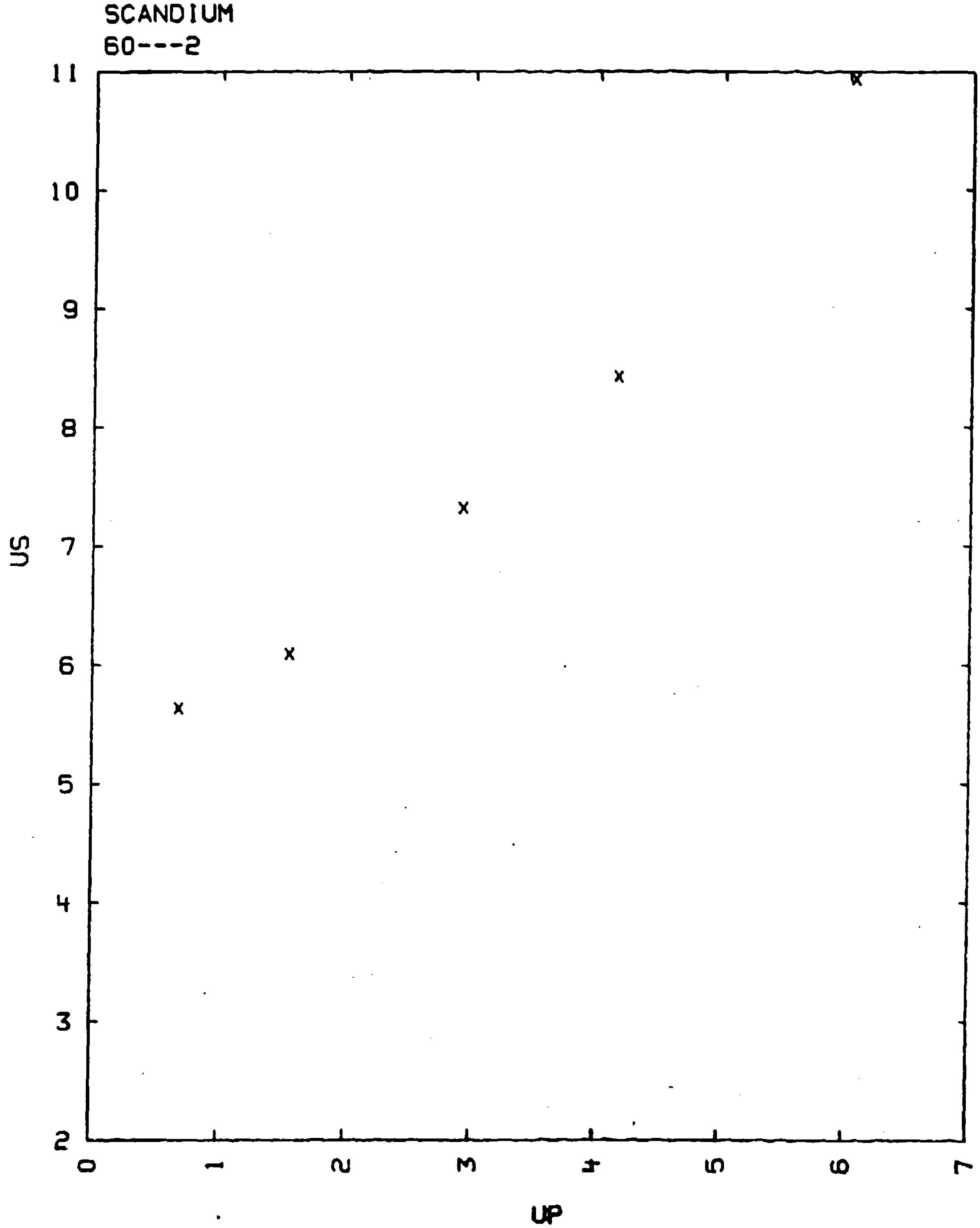
SAMPLE					STANDARD		
RHOO	US	UP	P	V/VO	MATERIAL	RHOO(ST)	US(ST)
3.09	10.94	6.04	2042.	0.448	IRON	7.85	11.21
-	8.42	4.16	1082.	0.506	IRON	7.85	8.83
-	7.31	2.93	662.	0.599	ALUMINUM	2.71	9.17
-	6.09	1.56	294.	0.744	ALUMINUM	2.71	7.34
-	5.63	0.69	120.	0.877	ALUMINUM	2.71	6.21

US = 5.05 + 0.746*UP KM/SEC FOR UP BELOW 3.72 KM/SEC
US = 2.83 + 1.342*UP KM/SEC FOR UP BETWEEN 3.72 AND 6.04 KM/SEC

COMMENTS:

1) SOURCE: ALTSHULER, L. V., BAKANOVA, A. A., DUDOLADOV, I. P.
ZHURNAL EKSP. TEORET. FIZIKI V. 53, P. 1967 (1967).
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) ONLY SHOCK VELOCITIES WERE MEASURED TO DETERMINE THE STRESS STATES. THE UNCERTAINTY IN THE SHOCK VELOCITIES WAS ESTIMATED TO BE 1.0 PERCENT.
4) HUGONIOTS OF STANDARD MATERIALS USED WERE AS FOLLOWS
ALUMINUM US = 5.25 + 1.39*UP FOR UP BETWEEN 0.0 AND 6.0 KM/SEC
IRON US = 3.85 + 1.615*UP FOR UP BETWEEN 1.0 AND 4.6 KM/SEC
5) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF THE HEXAGONAL CLOSE-PACKED STRUCTURE,
A = 3.3090 ANGSTROMS, C = 5.2733 ANGSTROMS (CA. 20 DEG. C)
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SIDNEY, 1963) 2ND EDITION, VOL. 1, P. 11.
6) THE DISCONTINUITY OF THE US VS. UP PLOT AT UP = 3.72 KM/SEC IS ATTRIBUTED TO AN ELECTRONIC PHASE CHANGE.

TABLE I



61---1
YTTRIUM

Y

VO = 0.2216 CC/G CL = 4.24 KM/SEC CO = 3.32 KM/SEC
VOI = 0.22364 CC/G CS = 2.28 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

SAMPLE						STANDARD	
RHOO	US	UFS	UP	P	V/VO	MATERIAL	P
4.513	4.16	2.13	1.24	234	0.705	ALUMINUM	238
4.513	4.52	3.03	1.62	329	0.640	BRASS	565
4.512	3.65	0.98	0.56	93	0.847	BRASS	147
4.512	6.37	6.21	3.14	905	0.508	BRASS	1480
4.511	5.26	4.72	2.35	556	0.552	ALUMINUM	556
4.514	4.89	3.77	1.92	423	0.607	ALUMINUM	423

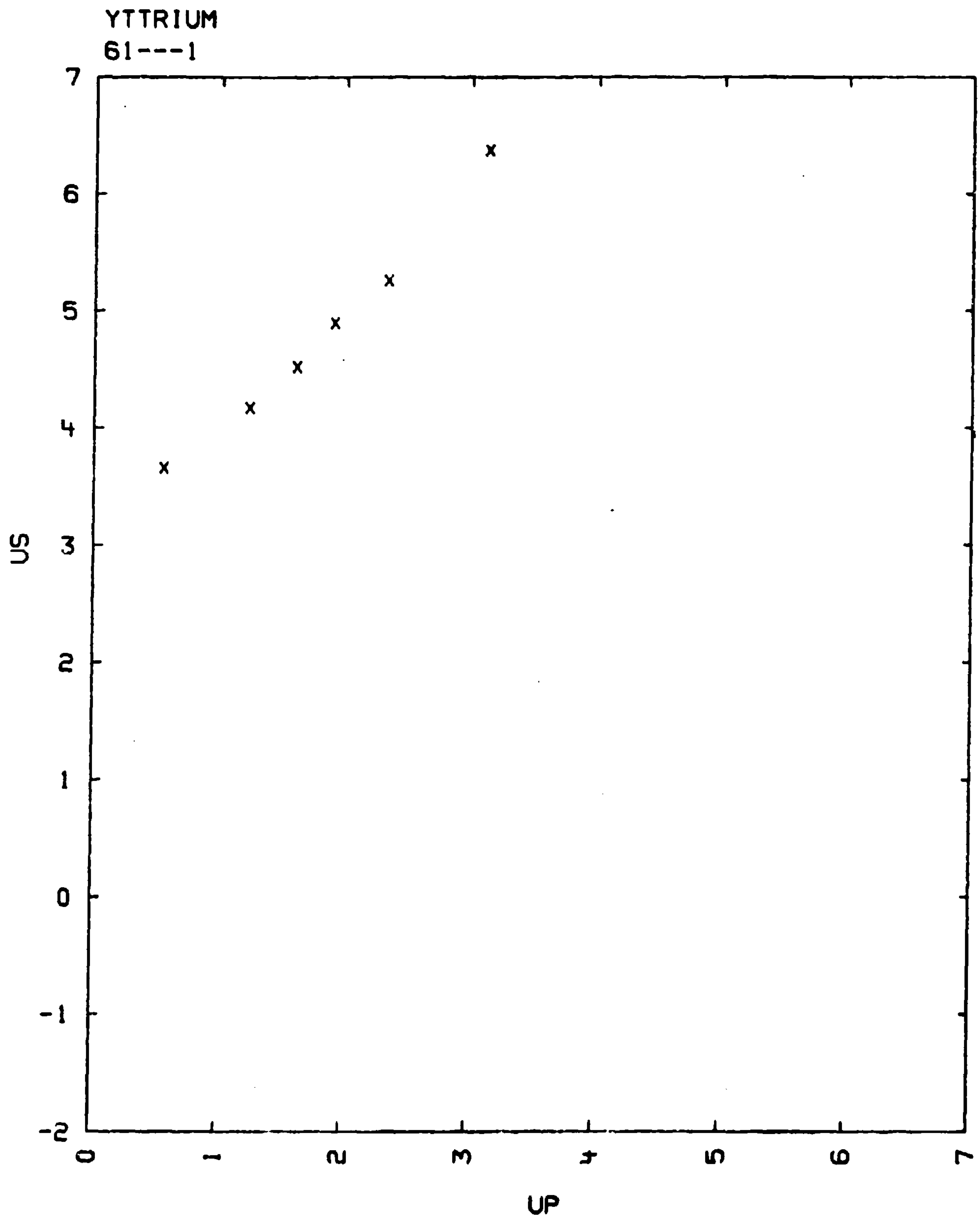
US =

COMMENTS:

1) SOURCE: GUST, W. H.
PRIVATE COMMUNICATION
UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY,
BOX 808, LIVERMORE, CALIFORNIA, 94550
2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION TECHNIQUE B.
3) THIS IS PRELIMINARY DATA AND FURTHER WORK IS IN PROGRESS. TAKING INTO ACCOUNT THE ACCURACY OF THE EXPERIMENTAL TECHNIQUE, THE DATA ARE BEST DESCRIBED BY MORE THAN ONE STRAIGHT LINE IN THE US VS. UP PLANE. THE SIGNIFICANCE OF THIS CHARACTERISTIC IS BEING INVESTIGATED.
4) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF THE HEXAGONAL CLOSE-PACKED STRUCTURE,
A = 3.6474 ANGSTROMS, C = 5.7306 ANGSTROMS
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SYDNEY, 1963) 2ND EDITION, VOL. 1, P. 11.
5) SOUND VELOCITIES WERE MEASURED BY H. L. DUNEGAN (SUPPORT ENGINEERING, ULTRASONIC GROUP) UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY, BOX 808, LIVERMORE, CALIFORNIA. 94550
6) THE LONGITUDINAL AND SHEAR VELOCITIES HAVE ALSO BEEN MEASURED BY SMITH, J. F., CARLSON, C. E. AND SPEDDING, F. H., ELASTIC PROPERTIES OF YTTRIUM AND ELEVEN OF THE RARE EARTH ELEMENTS, JOURNAL OF METALS (TRANSACTIONS AIME) OCT. 1957 P. 1212. THE MEASURED VALUES ARE:
CL = 4.280 PLUS OR MINUS 0.021 KM/SEC

CS = 2.420 PLUS OR MINUS 0.018 KM/SEC.

TABLE I



61---2
YTTRIUM

Y

VO = 0.223 CC/G CO = 3.23 KM/SEC
VOI = 0.22364 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

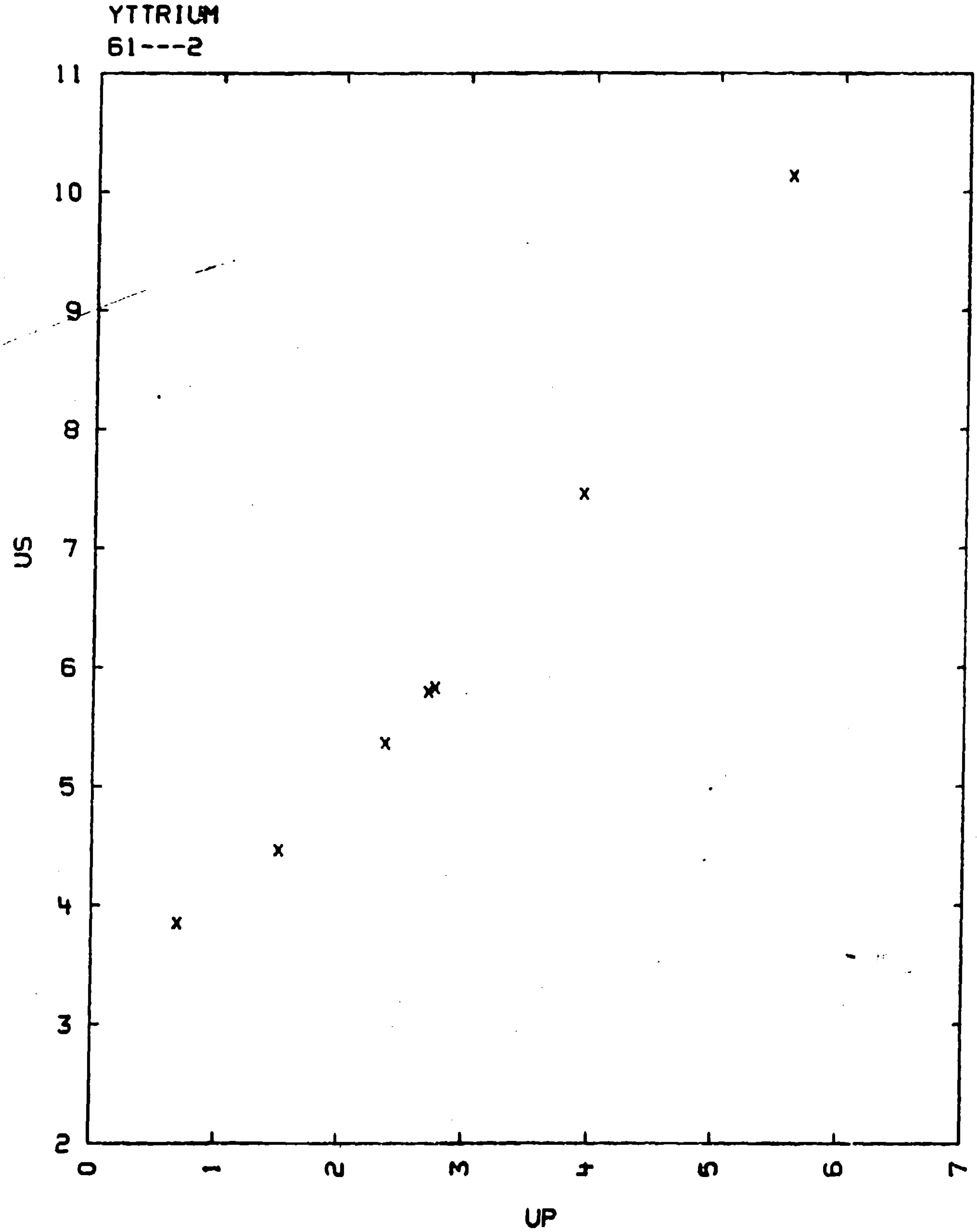
------------ SAMPLE				------------	-------- STANDARD		--------
RHOO	US	UP	P	V/VO	MATERIAL	RHOO(ST)	US(ST)
4.49	10.13	5.59	2542.	0.448	IRON	7.85	11.21
-	7.45	3.92	1311.	0.474	IRON	7.85	8.83
-	5.79	2.71	705.	0.532			
-	5.82	2.77	724.	0.524	ALUMINUM	2.71	9.17
-	5.36	2.37	570.	0.558			
-	4.46	1.52	304.	0.659	ALUMINUM	2.71	7.34
-	3.85	0.69	119.	0.821	ALUMINUM	2.71	6.21

US = 3.33 + 0.753*UP KM/SEC FOR UP BELOW 2.09 KM/SEC
US = 1.86 + 1.456*UP KM/SEC FOR UP BETWEEN 2.09 AND 5.59 KM/SEC

COMMENTS:

1) SOURCE: ALTSHULER, L. V., BAKANOVA, A. A., DUDOLADOV, I. P.
ZHURNAL EKSP. TEORET. FIZIKI V. 53, P. 1967 (1967).
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) ONLY SHOCK VELOCITIES WERE MEASURED TO DETERMINE THE STRESS STATES. THE UNCERTAINTY IN THE SHOCK VELOCITIES WAS ESTIMATED TO BE 1.0 PERCENT.
4) HUGONIOTS OF STANDARD MATERIALS USED WERE AS FOLLOWS
ALUMINUM US = 5.25 + 1.39*UP FOR UP BETWEEN 0.0 AND 6.0 KM/SEC
IRON US = 3.85 + 1.615*UP FOR UP BETWEEN 1.0 AND 4.6 KM/SEC
5) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF THE HEXAGONAL CLOSE-PACKED STRUCTURE,
A = 3.6474 ANGSTROMS, C = 5.7306 ANGSTROMS (CA. 20 DEG. C)
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SIDNEY, 1963) 2ND EDITION, VOL. 1, P. 11.
6) THE AUTHORS OBTAINED THE VALUE OF CO FROM HANDBOOK OF RARE METALS, (MIR PUBLISHERS, USSR, 1963) OR FROM C. KITTEL, INTRODUCTION TO SOLID STATE PHYSICS (FIZMATGIZ, USSR, 1963).
7) THE DISCONTINUITY OF THE US VS. UP PLOT AT UP = 2.09 KM/SEC IS ATTRIBUTED TO AN ELECTRONIC PHASE CHANGE.

TABLE I



62---1
LUTETIUM

LU

VO = 0.1026 CC/G
VOI = 0.10153 CC/G

CO = 2.13 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

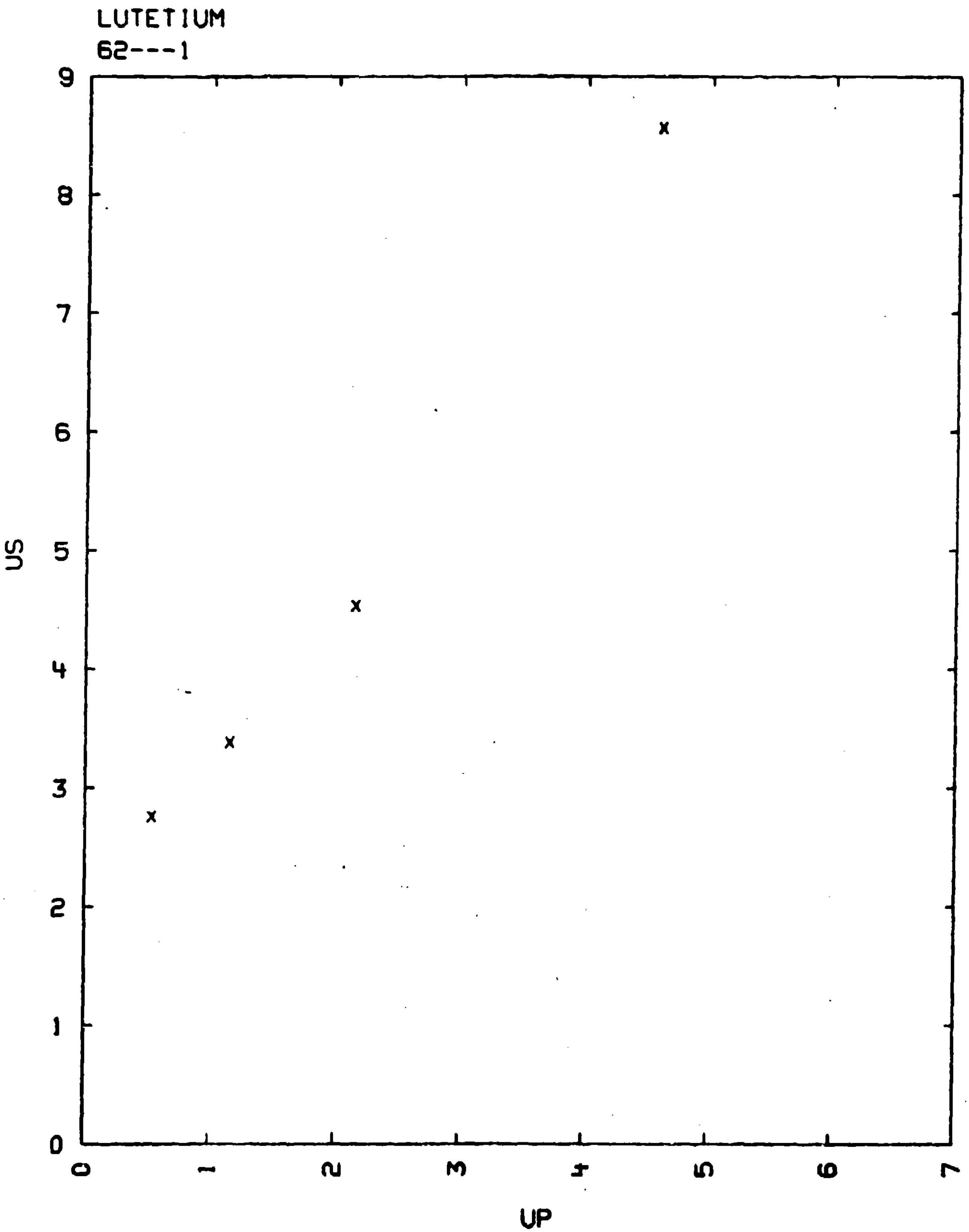
SAMPLE					STANDARD		
RHOO	US	UP	P	V/VO	MATERIAL	RHOO(ST)	US(ST)
9.74	8.56	4.60	3835.	0.463	IRON	7.85	11.21
-	4.53	2.16	953.	0.523	ALUMINUM	2.71	9.17
-	3.38	1.17	385.	0.654	ALUMINUM	2.71	7.34
-	2.76	0.54	145.	0.805	ALUMINUM	2.71	6.21

US = 2.20 + 1.00*UP KM/SEC FOR UP BELOW 1.88 KM/SEC
US = 0.98 + 1.65*UP KM/SEC FOR UP BETWEEN 1.88 AND 4.60 KM/SEC

COMMENTS:

1) SOURCE: ALTSHULER, L. V., BAKANOVA, A. A., DUDOLADOV, I. P.
ZHURNAL EKSP. TEORET. FIZIKI V. 53, P. 1967 (1967).
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) ONLY SHOCK VELOCITIES WERE MEASURED TO DETERMINE THE STRESS STATES.
THE UNCERTAINTY IN THE SHOCK VELOCITIES WAS ESTIMATED TO BE 1.0 PERCENT.
4) HUGONIOTS OF STANDARD MATERIALS USED HERE AS FOLLOWS
ALUMINUM US = 5.25 + 1.39*UP FOR UP BETWEEN 0.0 AND 6.0 KM/SEC
IRON US = 3.85 + 1.615*UP FOR UP BETWEEN 1.0 AND 4.6 KM/SEC
5) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF THE HEXAGONAL CLOSE-PACKED STRUCTURE.
A = 3.5031 ANGSTROMS, C = 5.5509 ANGSTROMS (CA. 20 DEG. C)
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SIDNEY, 1963) 2ND EDITION, VOL. 1, P. 11-
6) THE AUTHORS OBTAINED THE VALUE OF CO FROM HANDBOOK OF RARE METALS, (MIR PUBLISHERS, USSR, 1963) OR FROM C. KITTEL, INTRODUCTION TO SOLID STATE PHYSICS (FIZMATGIZ, USSR, 1963).
7) THE DISCONTINUITY OF THE US VS. UP PLOT AT UP = 1.88 KM/SEC IS ATTRIBUTED TO AN ELECTRONIC PHASE CHANGE.

TABLE I



63---1
YTTERBIUM

YB

VO = 0.1430 CC/G CL = 1.88 KM/SEC CO = 1.46 KM/SEC
VOI = 0.14368 CC/G CS = 1.02 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

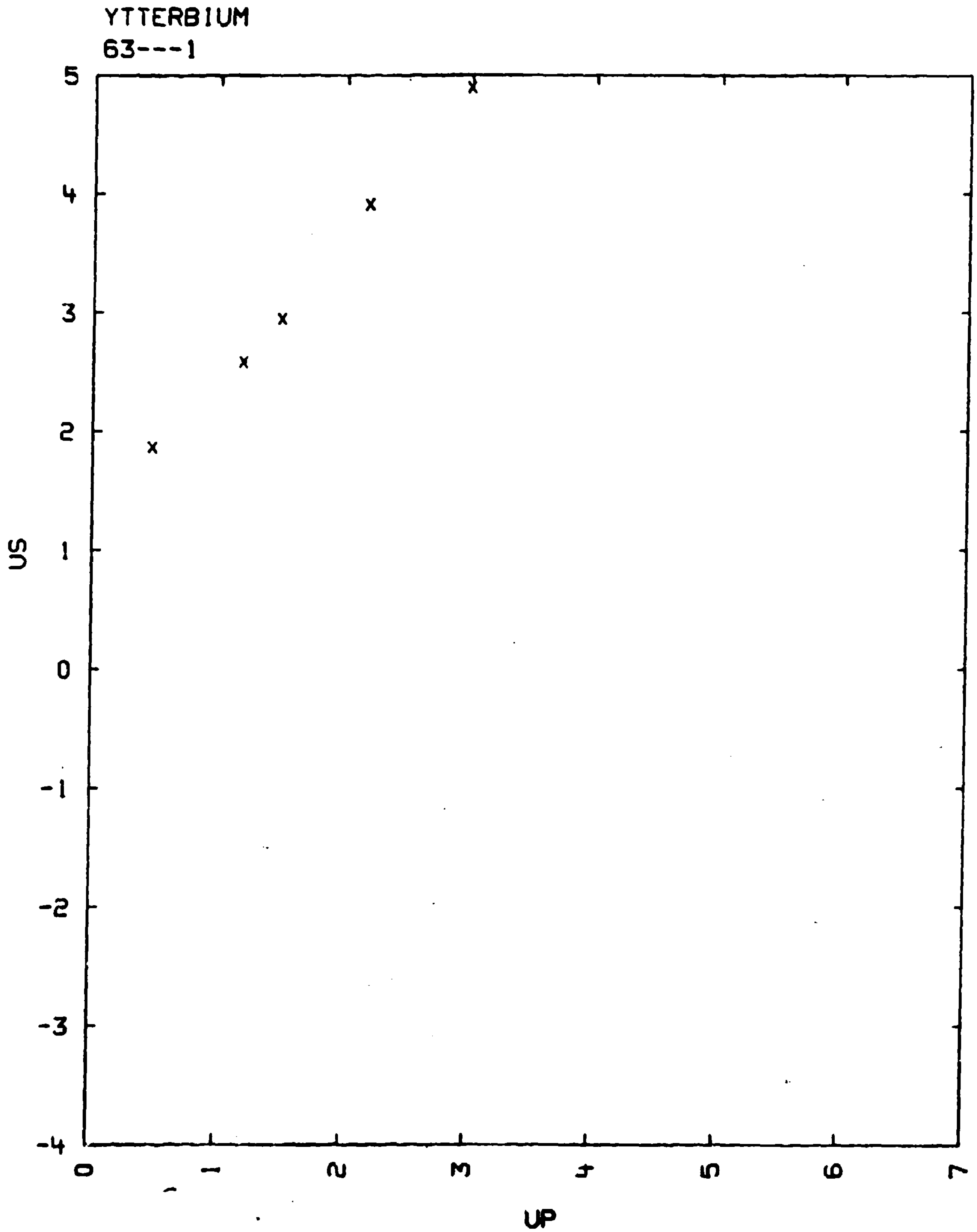
SAMPLE						STANDARD	
RHOO	US	UFS	UP	P	V/VO	MATERIAL	P
7.020	1.86	1.02	0.48	62	0.745	BRASS	118
7.021	4.89	5.98	2.99	1024	0.389	BRASS	1479
6.978	2.57	2.40	1.20	214	0.535	ALUMINUM	228
6.980	2.94	3.04	1.50	307	0.490	BRASS	506
6.977	3.90	4.40	2.18	593	0.440	ALUMINUM	537

US =

COMMENTS:

1) SOURCE: GUST, W. H.
PRIVATE COMMUNICATION
UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY,
BOX 808, LIVERMORE, CALIFORNIA, 94550
2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION TECHNIQUE B.
3) THIS IS PRELIMINARY DATA AND FURTHER WORK IS IN PROGRESS. TAKING INTO ACCOUNT THE ACCURACY OF THE EXPERIMENTAL TECHNIQUE, THE DATA ARE BEST DESCRIBED BY MORE THAN ONE STRAIGHT LINE IN THE US VS. UP PLANE. THE SIGNIFICANCE OF THIS CHARACTERISTIC IS BEING INVESTIGATED.
4) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANT OF THE CUBIC CLOSE-PACKED STRUCTURE,
A = 5.4862 ANGSTROMS
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SYDNEY, 1963) 2ND EDITION, VOL. 1, P. 10.
5) SOUND VELOCITIES WERE MEASURED BY H. L. DUNEGAN (SUPPORT ENGINEERING, ULTRASONIC GROUP) UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY, BOX 808, LIVERMORE, CALIFORNIA, 94550
6) THE LONGITUDINAL AND SHEAR VELOCITIES HAVE ALSO BEEN MEASURED BY SMITH, J. F., CARLSON, C. E. AND SPEDDING, F. H., ELASTIC PROPERTIES OF YTTRIUM AND ELEVEN OF THE RARE EARTH ELEMENTS, JOURNAL OF METALS (TRANSACTIONS AIME) OCT. 1957 P. 1212. THE MEASURED VALUES ARE:
CL = 1.820 PLUS OR MINUS 0.012 KM/SEC
CS = 0.999 PLUS OR MINUS 0.001 KM/SEC.

TABLE I



65---1
ERBIUM

ER

VO = 0.110 CC/G CO = 2.26 KM/SEC
VOI = 0.11033 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

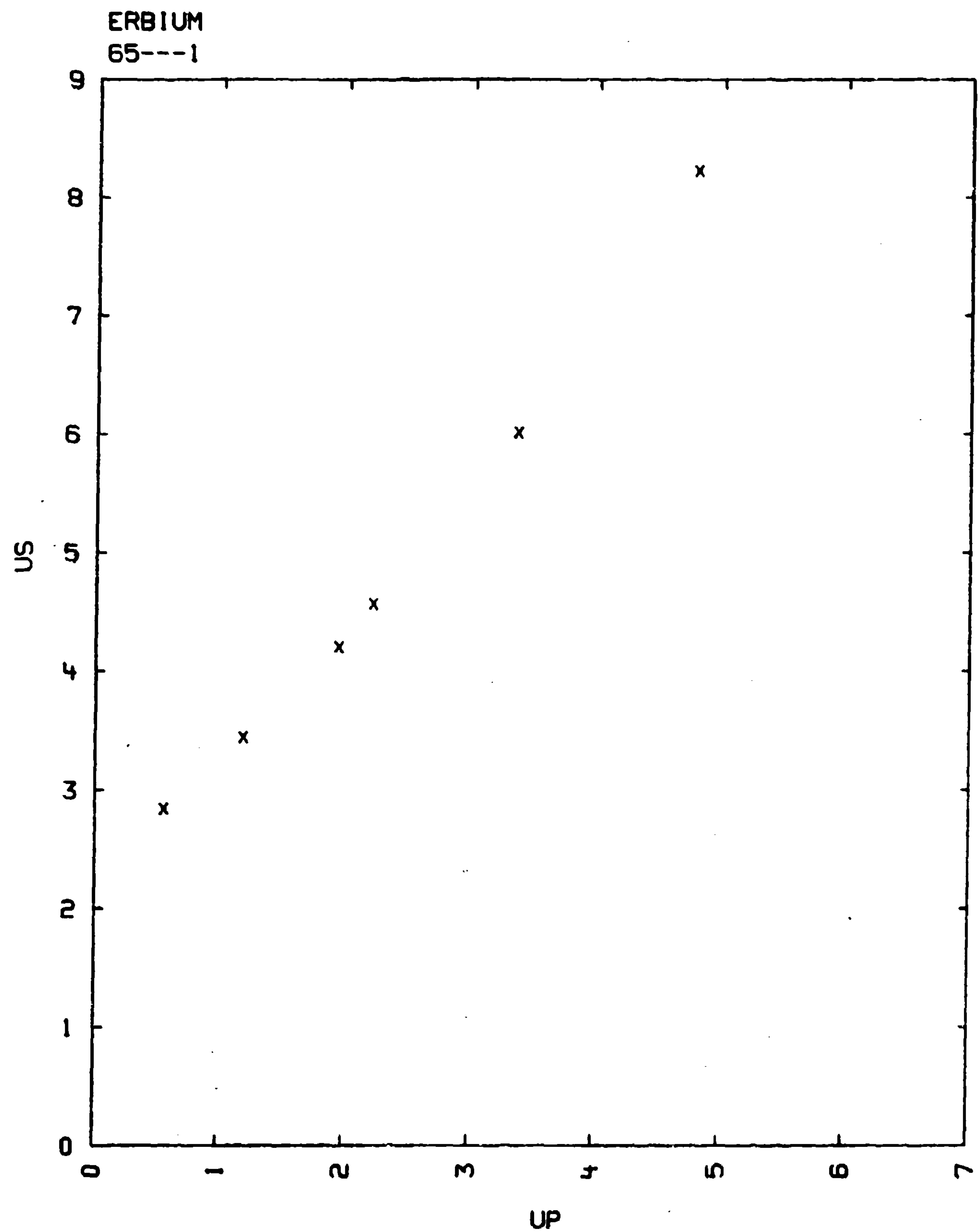
SAMPLE					STANDARD		
RHOO	US	UP	P	V/VO	MATERIAL	RHOO(ST)	US(ST)
9.05	8.22	4.79	3563.	0.417	IRON	7.85	11.21
-	6.01	3.37	1833.	0.439	IRON	7.85	8.83
-	4.56	2.23	920.	0.511	ALUMINUM	2.71	9.17
-	4.20	1.96	745.	0.533	COPPER	8.93	6.45
-	3.44	1.21	377.	0.648	ALUMINUM	2.71	7.34
-	2.84	0.56	144.	0.803	ALUMINUM	2.71	6.21

US = 2.20 + 1.033*UP KM/SEC FOR UP BELOW 2.71 KM/SEC
US = 0.77 + 1.560*UP KM/SEC FOR UP BETWEEN 2.71 AND 4.79 KM/SEC

COMMENTS:

1) SOURCE: ALTSHULER, L. V., BAKANOVA, A. A., DUDOLADOV, I. P.
ZHURNAL EKSP. TEORET. FIZIKI V. 53, P. 1967 (1967).
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) ONLY SHOCK VELOCITIES WERE MEASURED TO DETERMINE THE STRESS STATES. THE UNCERTAINTY IN THE SHOCK VELOCITIES WAS ESTIMATED TO BE 1.0 PERCENT.
4) HUGONIOTS OF STANDARD MATERIALS USED WERE AS FOLLOWS
ALUMINUM US = 5.25 + 1.39*UP FOR UP BETWEEN 0.0 AND 6.0 KM/SEC
COPPER US = 3.95 + 1.50*UP FOR UP BETWEEN 0.0 AND 4.0 KM/SEC
IRON US = 3.85 + 1.615*UP FOR UP BETWEEN 1.0 AND 4.6 KM/SEC
5) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF THE HEXAGONAL CLOSE-PACKED STRUCTURE.
A = 3.5588 ANGSTROMS, C = 5.5874 ANGSTROMS (CA. 20 DEG. C)
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SIDNEY, 1963) 2ND EDITION, VOL. 1, P. 11.
6) THE AUTHORS OBTAINED THE VALUE OF CO FROM HANDBOOK OF RARE METALS, (MIR PUBLISHERS, USSR, 1963) OR FROM C. KITTEL, INTRODUCTION TO SOLID STATE PHYSICS (FIZMATGIZ, USSR, 1963).
7) THE DISCONTINUITY OF THE US VS. UP PLOT AT UP = 2.71 KM/SEC IS ATTRIBUTED TO AN ELECTRONIC PHASE CHANGE.

TABLE I



67---1
DYSPROSIUM

DY

VO = 0.1168 CC/G CL = 2.96 KM/SEC CO = 2.19 KM/SEC
VOI = 0.11683 CC/G CS = 1.72 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

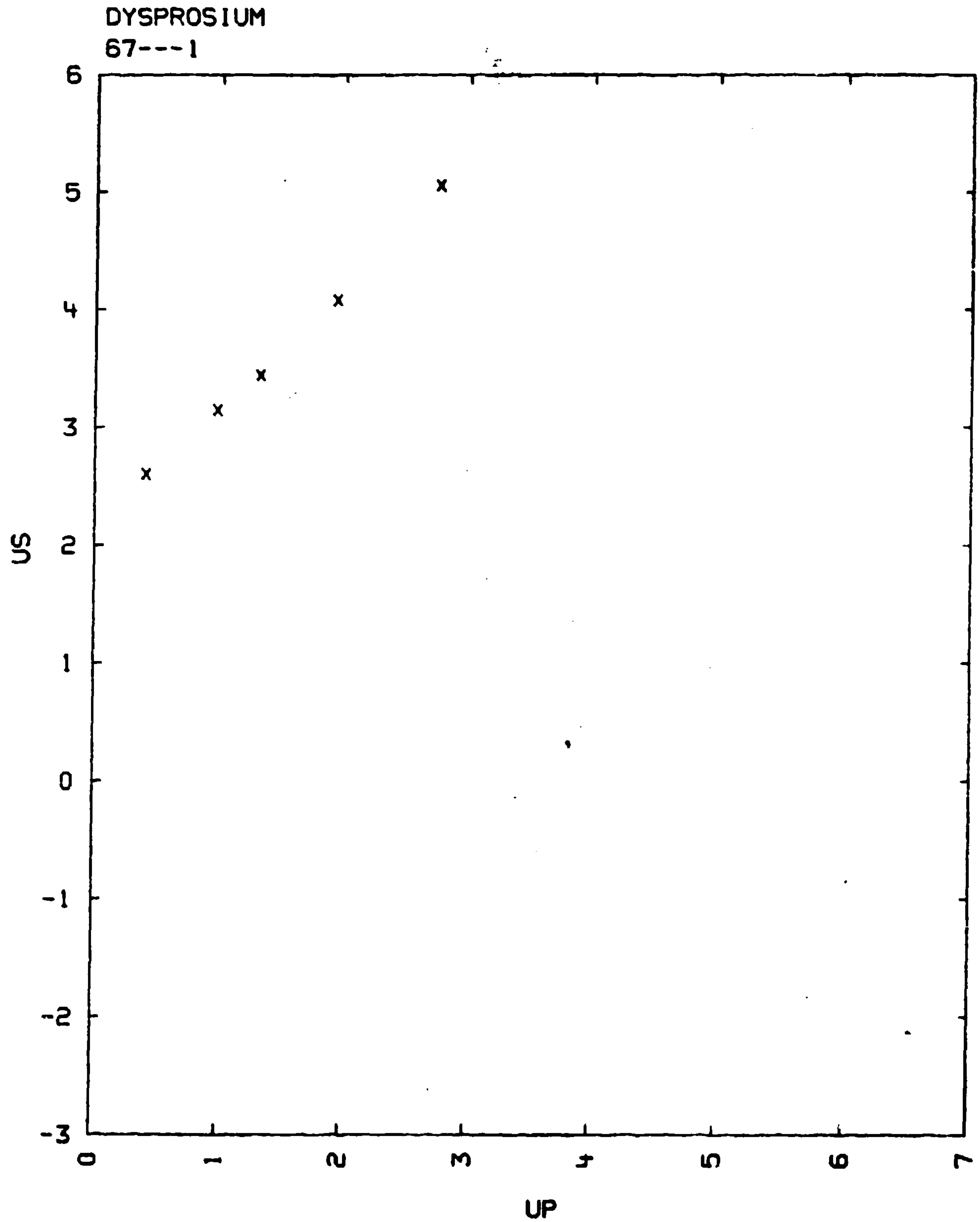
SAMPLE						STANDARD	
RHOO	US	UFS	UP	P	V/VO	MATERIAL	P
8.563	2.60	0.85	0.41	92	0.841	BRASS	118
8.557	5.05	5.66	2.77	1195	0.453	BRASS	1479
8.556	3.14	2.05	0.98	264	0.688	ALUMINUM	228
8.560	3.44	2.71	1.33	391	0.615	BRASS	506
8.559	4.07	3.91	1.95	679	0.522	ALUMINUM	537

US =

COMMENTS:

1) SOURCE: GUST, W. H.
PRIVATE COMMUNICATION
UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY, BOX 808, LIVERMORE, CALIFORNIA. 94550
2) EXPERIMENTAL TECHNIQUE B .
DATA REDUCTION TECHNIQUE B.
3) THIS IS PRELIMINARY DATA AND FURTHER WORK IS IN PROGRESS. TAKING INTO ACCOUNT THE ACCURACY OF THE EXPERIMENTAL TECHNIQUE THE DATA ARE BEST DESCRIBED BY MORE THAN ONE STRAIGHT LINE IN THE US VS. UP PLANE. THE SIGNIFICANCE OF THIS CHARACTERISTIC IS BEING INVESTIGATED.
4) THE VALUE OF VOI HAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF THE HEXAGONAL CLOSE-PACKED STRUCTURE,
A = 3.5903 ANGSTROMS, C = 5.6475 ANGSTROMS (CA. 20 DEG. C.)
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SYDNEY, 1963) 2ND EDITION, VOL. 1, P. 11.
5) SOUND VELOCITIES WERE MEASURED BY H. L. DUNEGAN (SUPPORT ENGINEERING, ULTRASONIC GROUP) UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY, BOX 808, LIVERMORE, CALIFORNIA. 94550
6) THE LONGITUDINAL AND SHEAR VELOCITIES HAVE ALSO BEEN MEASURED BY SMITH, J.F., CARLSON, C. E. AND SPEDDING, F. H., ELASTIC PROPERTIES OF YTTRIUM AND ELEVEN OF THE RARE EARTH ELEMENTS, JOURNAL OF METALS (TRANSACTIONS AIME) OCT. 1957 P. 1212. THE MEASURED VALUES ARE:
CL = 2.958 PLUS OR MINUS 0.008 KM/SEC
CS = 1.724 PLUS OR MINUS 0.009 KM/SEC.

TABLE I



67---2
DYSPROSIUM

DY

VO = 0.121 CC/G   CO = 2.19 KM/SEC
VOI = 0.11683 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

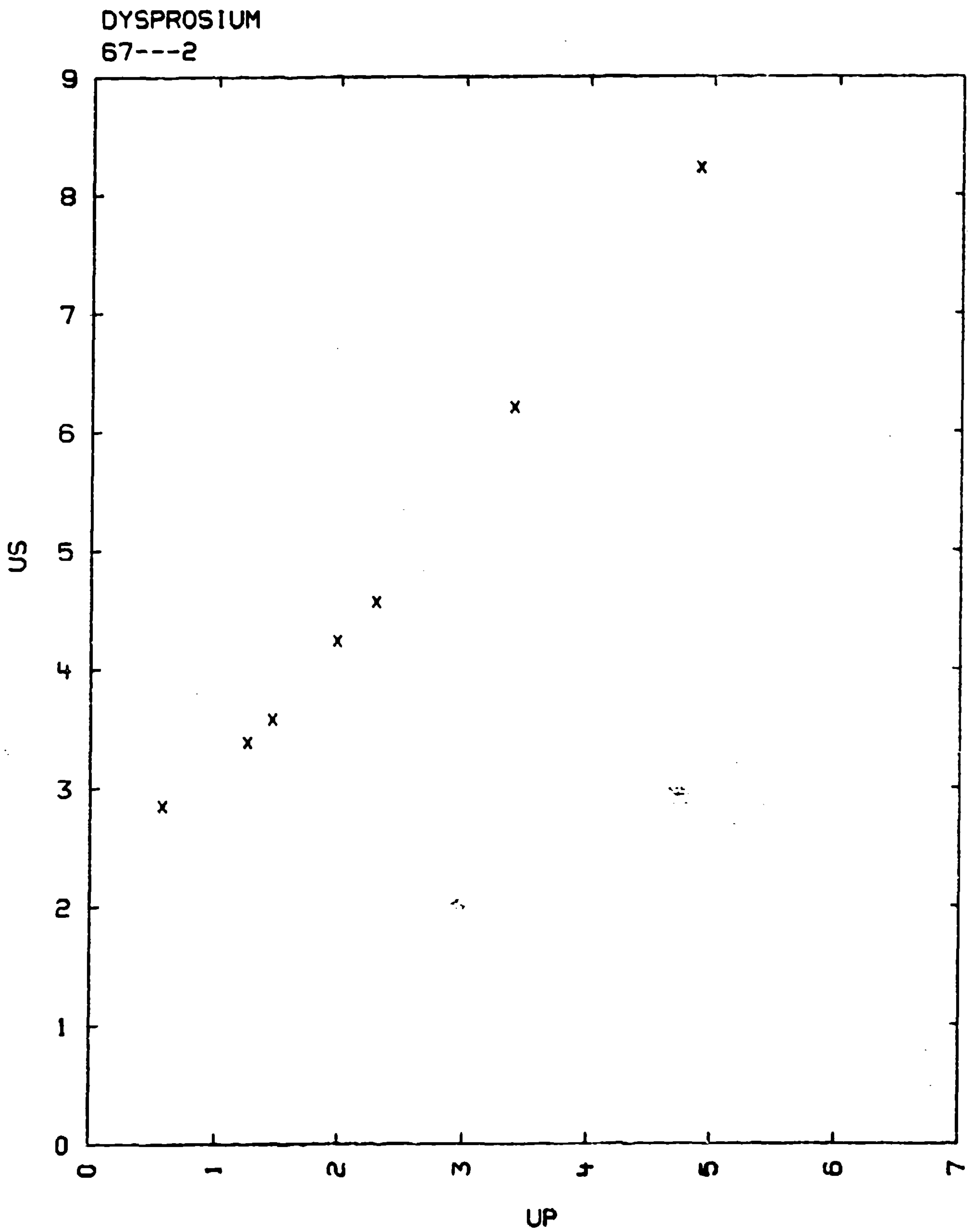
SAMPLE					STANDARD		
RHO0	US	UP	P	V/V0	MATERIAL	RHO(ST)	US(ST)
8.52	8.22	4.89	3425.	0.405	IRON	7.85	11.21
-	6.20	3.40	1796.	0.452	IRON	7.85	8.83
-	4.56	2.30	893.	0.496	ALUMINUM	2.71	9.17
-	4.23	1.99	717.	0.530	COPPER	8.93	6.45
-	3.57	1.47	447.	0.588			
-	3.38	1.26	362.8	0.627	ALUMINUM	2.71	7.34
-	2.85	0.57	138.4	0.800	ALUMINUM	2.71	6.21

US = 2.37 + 0.81*UP KM/SEC FOR UP BELOW 1.70 KM/SEC
US = 1.34 + 1.417*UP KM/SEC FOR UP BETWEEN 1.70 AND 4.89 KM/SEC

COMMENTS:

1) SOURCE: ALTSHULER, L. V., BAKANOVA, A. A., DUDOLADOV, I. P.
ZHURNAL EKSP. TEORET. FIZIKI V. 53, P. 1967 (1967).
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) ONLY SHOCK VELOCITIES WERE MEASURED TO DETERMINE THE STRESS STATES. THE UNCERTAINTY IN THE SHOCK VELOCITIES WAS ESTIMATED TO BE 1.0 PERCENT.
4) HUGONIOTS OF STANDARD MATERIALS USED WERE AS FOLLOWS
ALUMINUM US = 5.25 + 1.39*UP FOR UP BETWEEN 0.0 AND 6.0 KM/SEC
COPPER US = 3.95 + 1.50*UP FOR UP BETWEEN 0.0 AND 4.0 KM/SEC
IRON US = 3.85 + 1.615*UP FOR UP BETWEEN 1.0 AND 4.6 KM/SEC
5) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF THE HEXAGONAL CLOSE-PACKED STRUCTURE.
A = 3.5903 ANGSTROMS, C = 5.6475 ANGSTROMS (CA. 20 DEG. C)
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SIDNEY, 1963) 2ND EDITION, VOL. 1, P. 11.
6) THE AUTHORS OBTAINED THE VALUE OF CO FROM HANDBOOK OF RARE METALS, (MIR PUBLISHERS, USSR, 1963) OR FROM C. KITTEL, INTRODUCTION TO SOLID STATE PHYSICS (FIZMATGIZ, USSR, 1963).
7) THE DISCONTINUITY OF THE US VS. UP PLOT AT UP = 1.70 KM/SEC IS ATTRIBUTED TO AN ELECTRONIC PHASE CHANGE.

TABLE I



69---1
GADOLINIUM

GD

VO = 0.1264 CC/G   CL = 2.94 KM/SEC   CO = 2.21 KM/SEC
VOI = 0.12678 CC/G   CS = 1.68 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

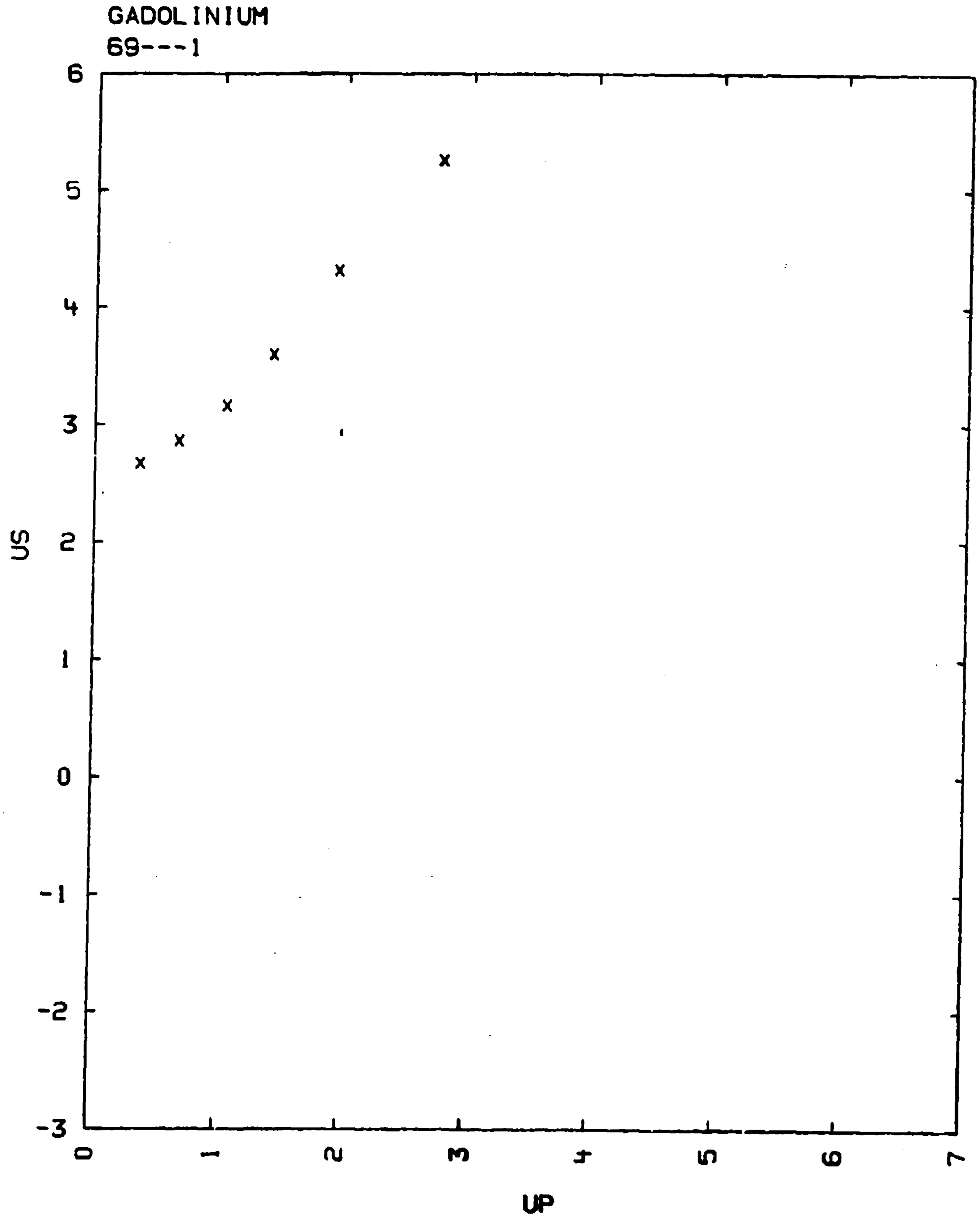
SAMPLE						STANDARD	
RHOO	US	UFS	UP	P	V/VO	MATERIAL	P
7.937	2.67	0.93	0.36	100	0.819	BRASS	139
7.933	3.60	2.82	1.42	405	0.606	BRASS	547
7.941	5.26	5.69	2.76	1151	0.476	BRASS	1433
7.892	3.15	2.06	1.05	261	0.665	ALUMINUM	230
7.891	4.31	3.99	1.94	657	0.551	ALUMINUM	534
7.893	2.86	1.49	0.67	151	0.765	ALUMINUM	135

US =

COMMENTS:

1) SOURCE: GUST, W. H.
PRIVATE COMMUNICATION
UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY,
BOX 808, LIVERMORE, CALIFORNIA. 94550
2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION TECHNIQUE B.
3) THIS IS PRELIMINARY DATA AND FURTHER WORK IS IN PROGRESS. TAKING INTO ACCOUNT THE ACCURACY OF THE EXPERIMENTAL TECHNIQUE, THE DATA ARE BEST DESCRIBED BY MORE THAN ONE STRAIGHT LINE IN THE US VS. UP PLANE. THE SIGNIFICANCE OF THIS CHARACTERISTIC IS BEING INVESTIGATED.
4) THE VALUE OF VOI HAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF THE HEXAGONAL CLOSE-PACKED STRUCTURE,
A = 3.6360 ANGSTROMS, C = 5.7826 ANGSTROMS (CA. 20 DEG. C.)
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SYDNEY, 1963) 2ND EDITION, VOL. 1
5) SOUND VELOCITIES WERE MEASURED BY H. L. DUNEGAN (SUPPORT ENGINEERING, ULTRASONIC GROUP) UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY, BOX 808, LIVERMORE, CALIFORNIA. 94550
6) THE LONGITUDINAL AND SHEAR VELOCITIES HAVE ALSO BEEN MEASURED BY SMITH, J. F., CARLSON, C. E. AND SPEDDING, F. H., ELASTIC PROPERTIES OF YTTRIUM AND ELEVEN OF THE RARE EARTH ELEMENTS, JOURNAL OF METALS (TRANSACTIONS AIME) OCT. 1957 P. 1212. THE MEASURED VALUES ARE:
CL = 2.951 PLUS OR MINUS 0.003 KM/SEC
CS = 1.682 PLUS OR MINUS 0.002 KM/SEC.

TABLE I



69---2
GADOLINIUM

GD

VO = 0.126 CC/G
VOI = 0.1268 CC/G

CO = 2.25 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

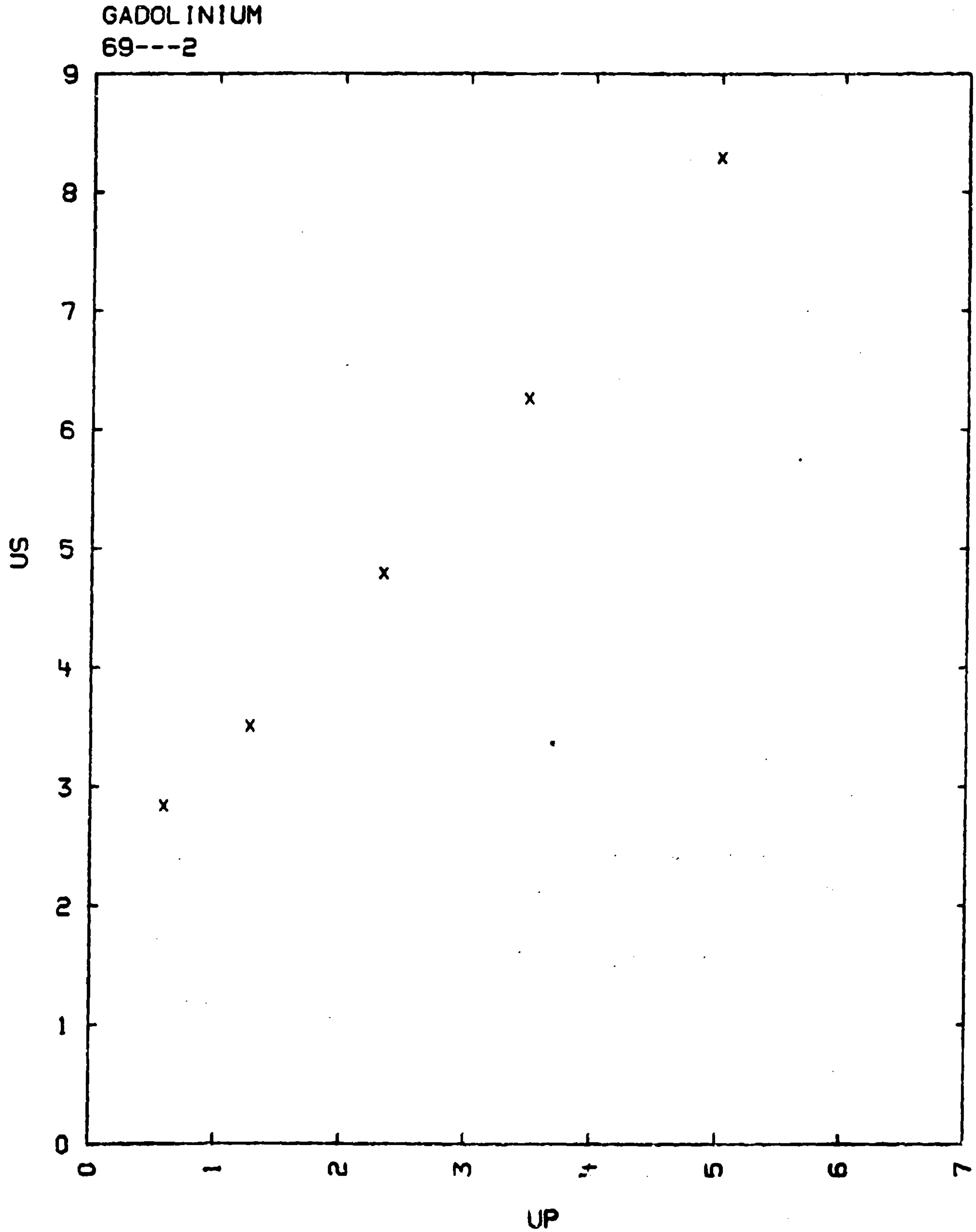
SAMPLE					STANDARD		
RHOO	US	UP	P	V/VO	MATERIAL	RHOO(ST)	US(ST)
7.93	8.29	5.00	3287.	0.397	IRON	7.85	11.21
-	6.26	3.48	1728.	0.444	IRON	7.85	8.83
-	4.79	2.33	885.	0.514	ALUMINUM	2.71	9.17
-	3.51	1.28	356.	0.635	ALUMINUM	2.71	7.34
-	2.83	0.60	135.	0.788	ALUMINUM	2.71	6.21

US = 2.25 + 0.98*UP KM/SEC FOR UP BELOW 1.74 KM/SEC
US = 1.650 + 1.325*UP KM/SEC FOR UP BETWEEN 1.74 AND 5.00 KM/SEC

COMMENTS:

1) SOURCE: ALTSHULER, L. V., BAKANOVA, A. A., DUDOLADOV, I. P.
ZHURNAL EKSP. TEORET. FIZIKI V. 53, P. 1967 (1967).
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) ONLY SHOCK VELOCITIES WERE MEASURED TO DETERMINE THE STRESS STATES. THE UNCERTAINTY IN THE SHOCK VELOCITIES WAS ESTIMATED TO BE 1.0 PERCENT.
4) HUGONIOTS OF STANDARD MATERIALS USED WERE AS FOLLOWS
ALUMINUM US = 5.25 + 1.39*UP FOR UP BETWEEN 0.0 AND 6.0 KM/SEC
IRON US = 3.85 + 1.615*UP FOR UP BETWEEN 1.0 AND 4.6 KM/SEC
5) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF THE HEXAGONAL CLOSE-PACKED STRUCTURE.
A = 3.636 ANGSTROMS, C = 5.7826 ANGSTROMS (CA. 20 DEG. C)
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SIDNEY, 1963) 2ND EDITION, VOL. 1, P. 11.
6) THE AUTHORS OBTAINED THE VALUE OF CO FROM HANDBOOK OF RARE METALS, (MIR PUBLISHERS, USSR, 1963) OR FROM C. KITTEL, INTRODUCTION TO SOLID STATE PHYSICS (FIZMATGIZ, USSR, 1963).
7) THE DISCONTINUITY OF THE US VS. UP PLOT AT UP = 1.74 KM/SEC IS ATTRIBUTED TO AN ELECTRONIC PHASE CHANGE.

TABLE I



70---1
EUROPIUM

EU

VO = 0.1878 CC/G   CL = 2.26 KM/SEC   CO = 1.79 KM/SEC
VOI = 0.1936 CC/G   CS = 1.19 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

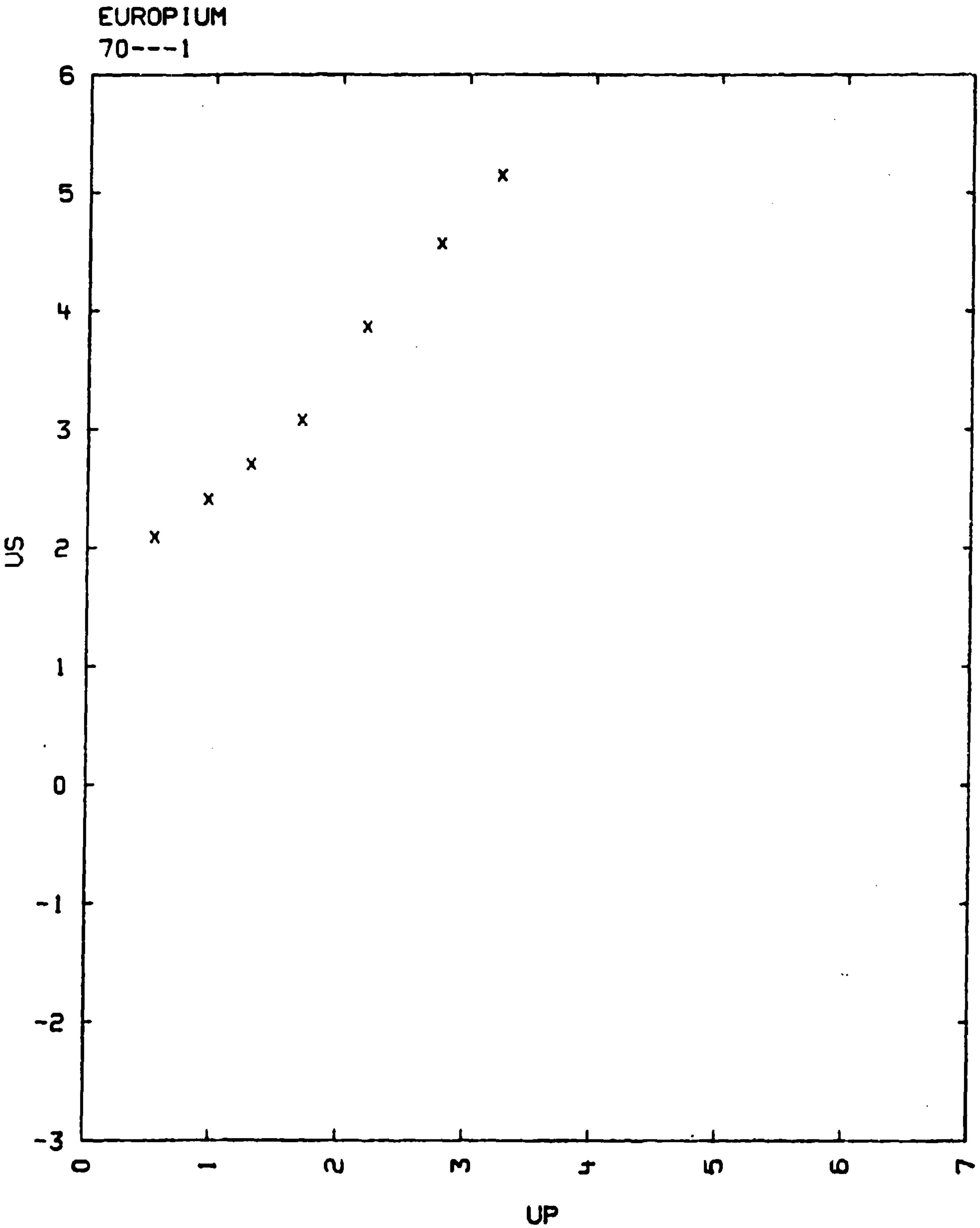
SAMPLE						STANDARD	
RHOO	US	UFS	UP	P	V/VO	MATERIAL	P
5.402	2.09	1.01	0.54	61	0.741	BRASS	131
5.253	3.07	3.30	1.70	274	0.446	BRASS	553
5.400	5.14	6.57	3.26	903	0.366	BRASS	1530
5.294	2.70	2.69	1.30	186	0.518	ALUMINUM	221
5.301	4.56	5.77	2.79	673	0.388	ALUMINUM	688
5.301	2.40		0.97	123	0.597	ALUMINUM	149
5.302	3.86	4.38	2.21	452	0.428	ALUMINUM	472

US

COMMENTS:

1) SOURCE: GUST, W. H.
PRIVATE COMMUNICATION
UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY, BOX 808, LIVERMORE, CALIFORNIA. 94550
2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION TECHNIQUE B.
3) THIS IS PRELIMINARY DATA AND FURTHER WORK IS IN PROGRESS. TAKING INTO ACCOUNT THE ACCURACY OF THE EXPERIMENTAL TECHNIQUE, THE DATA ARE BEST DESCRIBED BY MORE THAN ONE STRAIGHT LINE IN THE US VS. UP PLANE. THE SIGNIFICANCE OF THIS CHARACTERISTIC IS BEING INVESTIGATED.
4) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANT OF THE CUBIC BODY CENTERED STRUCTURE,
A = 4.606 ANGSTROMS
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SYDNEY, 1963) 2ND EDITION, VOL. 1, P. 16.
5) SOUND VELOCITIES WERE MEASURED BY H. L. DUNEGAN (SUPPORT ENGINEERING, ULTRASONIC GROUP) UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY, BOX 808, LIVERMORE, CALIFORNIA. 94550

TABLE I



71---1
SAMARIUM

SM

VO = 0.1338 CC/G CL = 2.92 KM/SEC CO = 2.23 KM/SEC
VOI = 0.1327 CC/G CS = 1.63 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

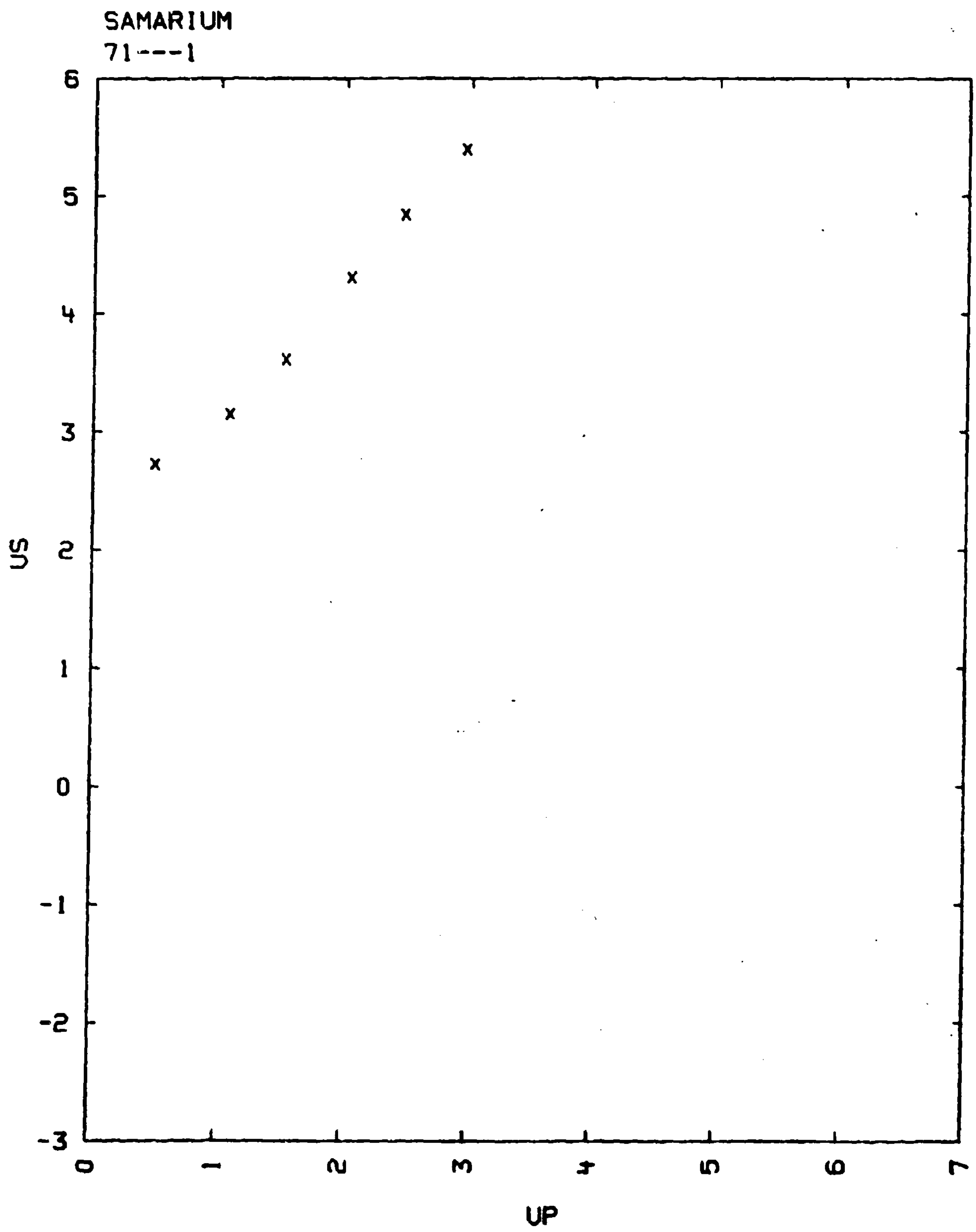
SAMPLE						STANDARD	
RHOO	US	UFS	UP	P	V/VO	MATERIAL	P
7.452	2.72	0.94	0.50	101	0.819	BRASS	149
7.505	3.61	2.93	1.53	414	0.577	BRASS	583
7.451	5.39	6.11	2.96	1188	0.450	BRASS	1570
7.475	3.14	2.12	1.09	254	0.654	ALUMINUM	233
7.477	4.30	4.23	2.04	654	0.526	ALUMINUM	542
7.478	4.83	5.11	2.47	891	0.489	ALUMINUM	730

US =

COMMENTS:

1) SOURCE: GUST, W. H.
PRIVATE COMMUNICATION
UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY,
BOX 808, LIVERMORE, CALIFORNIA, 94550
2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION TECHNIQUE B.
3) THIS IS PRELIMINARY DATA AND FURTHER WORK IS IN PROGRESS. TAKING INTO ACCOUNT THE ACCURACY OF THE EXPERIMENTAL TECHNIQUE, THE DATA ARE BEST DESCRIBED BY MORE THAN ONE STRAIGHT LINE IN THE US VS. UP PLANE. THE SIGNIFICANCE OF THIS CHARACTERISTIC IS BEING INVESTIGATED.
4) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF A HEXAGONAL UNIT CELL CONTAINING NINE ATOMS,
A = 3.621 ANGSTROMS, C = 26.25 ANGSTROMS
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SYDNEY, 1963) 2ND EDITION, VOL. 1, P. 24.
5) SOUND VELOCITIES WERE MEASURED BY H. L. DUNEGAN (SUPPORT ENGINEERING, ULTRASONIC GROUP) UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY, BOX 808, LIVERMORE, CALIFORNIA, 94550
6) THE LONGITUDINAL AND SHEAR VELOCITIES HAVE ALSO BEEN MEASURED BY SMITH, J. F., CARLSON, C. E. AND SPEDDING, F. H., ELASTIC PROPERTIES OF YTTRIUM AND ELEVEN OF THE RARE EARTH ELEMENTS, JOURNAL OF METALS (TRANSACTIONS AIME) OCT. 1957 P. 1212. THE MEASURED VALUES ARE:
CL = 2.702 PLUS OR MINUS 0.004 KM/SEC
CS = 1.292 PLUS OR MINUS 0.017 KM/SEC.

TABLE I



71---2
SAMARIUM

SM

VO = 0.133 CC/G　　　　CO = 2.26 KM/SEC
VOI = 0.1327 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

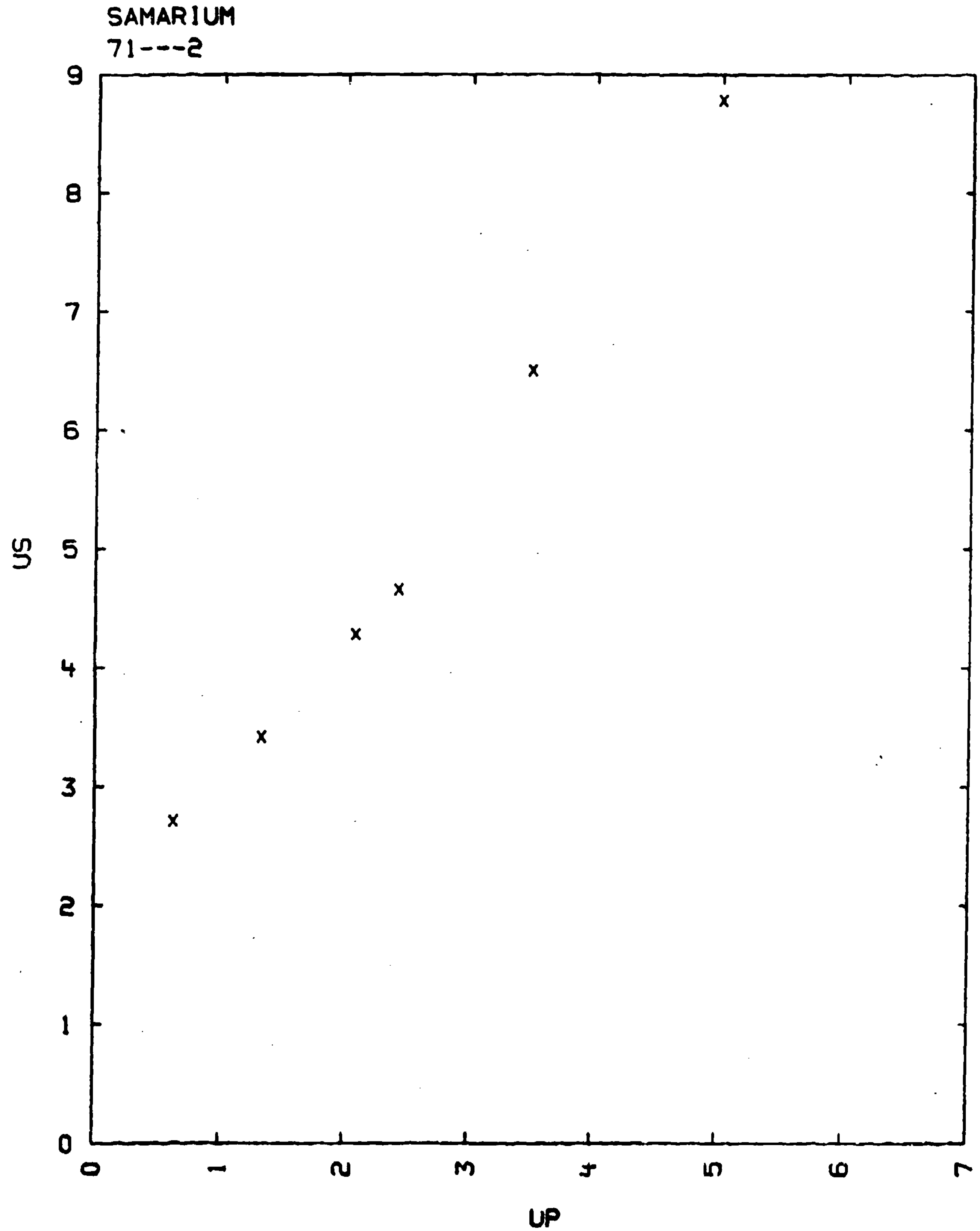
SAMPLE					STANDARD		
RHOO	US	UP	P	V/VO	MATERIAL	RHOO(ST)	US(ST)
7.50	8.78	5.00	3293.	0.430	IRON	7.85	11.21
-	6.49	3.49	1699	0.462	IRON	7.85	8.83
-	4.65	2.43	847.	0.477	ALUMINUM	2.71	9.17
-	4.28	2.09	671.	0.512	COPPER	8.93	6.45
-	3.42	1.34	344.	0.608	ALUMINUM	2.71	7.34
-	2.71	0.63	128.	0.767	ALUMINUM	2.71	6.21

US = 2.19 + 0.88*UP KM/SEC　FOR UP BELOW 1.87 KM/SEC
US = 0.84 + 1.600*UP KM/SEC　FOR UP BETWEEN 1.87 AND 5.00 KM/SEC

COMMENTS:

1) SOURCE: ALTSHULER, L. V., BAKANOVA, A. A., DUDOLADOV, I. P.
ZHURNAL EKSP. TEORET. FIZIKI V. 53, P. 1967 (1967).
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) ONLY SHOCK VELOCITIES WERE MEASURED TO DETERMINE THE STRESS STATES. THE UNCERTAINTY IN THE SHOCK VELOCITIES WAS ESTIMATED TO BE 1.0 PERCENT.
4) HUGONIOTS OF STANDARD MATERIALS USED WERE AS FOLLOWS
ALUMINUM　US = 5.25 + 1.39*UP　FOR UP BETWEEN 0.0 AND 6.0 KM/SEC
COPPER　US = 3.95 + 1.50*UP　FOR UP BETWEEN 0.0 AND 4.0 KM/SEC
IRON　US = 3.85 + 1.615*UP　FOR UP BETWEEN 1.0 AND 4.6 KM/SEC
5) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF A HEXAGONAL UNIT CELL CONTAINING 9 ATOMS
A = 3.621 ANGSTROMS, C = 26.25 ANGSTROMS
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SIDNEY, 1963) 2ND EDITION, VOL. 1, P. 24.
6) THE AUTHORS OBTAINED THE VALUE OF CO FROM HANDBOOK OF RARE METALS, (MIR PUBLISHERS, USSR, 1963) OR FROM C. KITTEL, INTRODUCTION TO SOLID STATE PHYSICS (FIZMATGIZ, USSR, 1963).
7) THE DISCONTINUITY OF THE US VS. UP PLOT AT UP = 1.87 KM/SEC IS ATTRIBUTED TO AN ELECTRONIC PHASE CHANGE.

TABLE I



73---1
NEODYMIUM

ND

VO = 0.1427 CC/G   CL = 2.82 KM/SEC   CO = 2.18 KM/SEC
VOI = 0.1427 CC/G   CS = 1.55 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

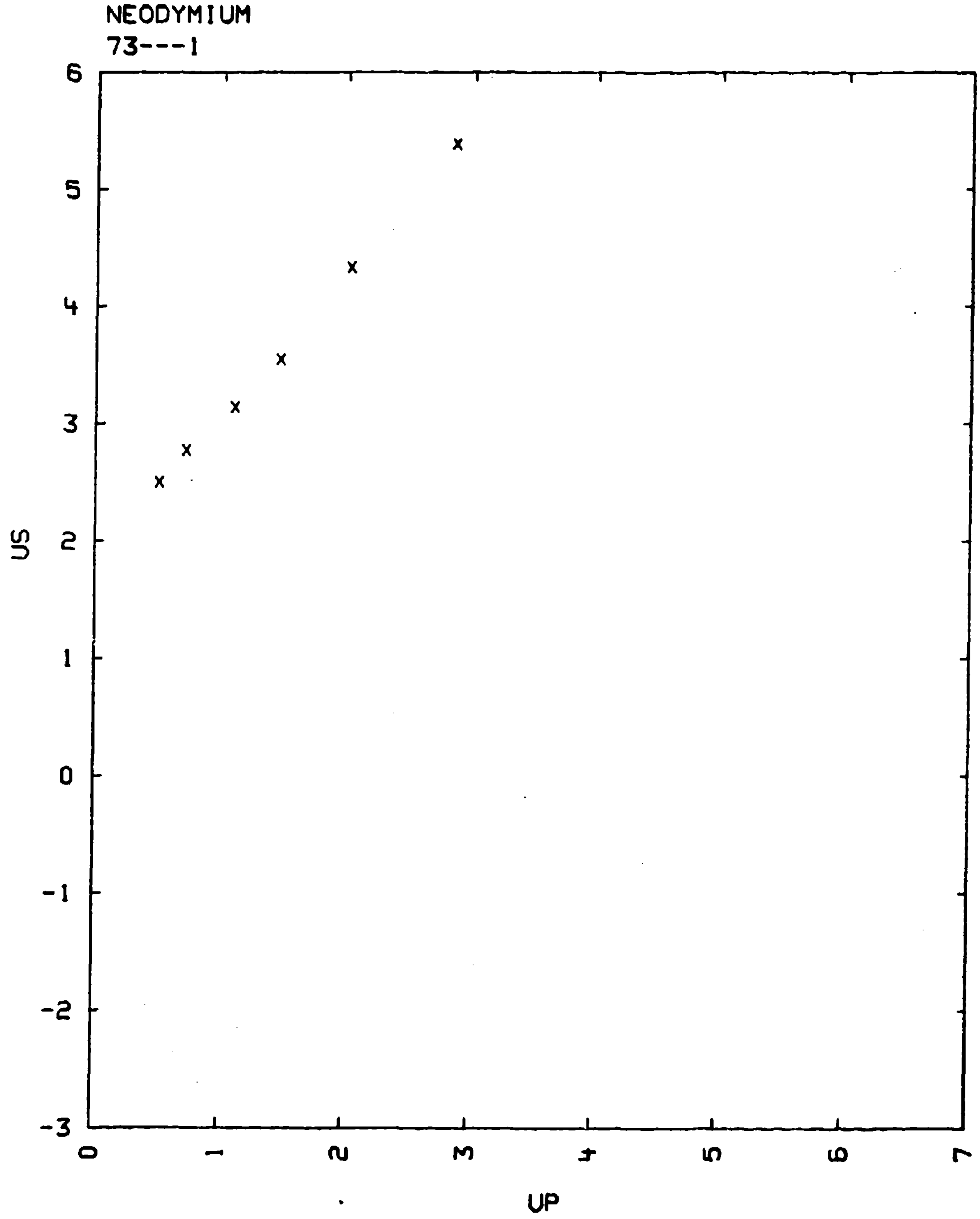
SAMPLE						STANDARD	
RHOO	US	UFS	UP	P	V/VO	MATERIAL	P
7.012	2.50	1.00	0.51	89	0.799	BRASS	139
7.008	3.54	2.93	1.48	369	0.581	BRASS	547
7.007	5.38	5.90	2.86	1075	0.469	BRASS	1433
7.010	3.13	2.21	1.11	243	0.644	ALUMINUM	230
7.002	4.32	4.31	2.03	618	0.526	ALUMINUM	534
7.005	2.77	1.58	0.73	141	0.738	ALUMINUM	135

US =

COMMENTS:

1) SOURCE: GUST, W. H.
PRIVATE COMMUNICATION
UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY, BOX 808, LIVERMORE, CALIFORNIA. 94550
2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION TECHNIQUE B.
3) THIS IS PRELIMINARY DATA AND FURTHER WORK IS IN PROGRESS. TAKING INTO ACCOUNT THE ACCURACY OF THE EXPERIMENTAL TECHNIQUE, THE DATA ARE BEST DESCRIBED BY MORE THAN ONE STRAIGHT LINE IN THE US VS. UP PLANE. THE SIGNIFICANCE OF THIS CHARACTERISTIC IS BEING INVESTIGATED.
4) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF THE HEXAGONAL CLOSE-PACKED STRUCTURE.
A = 3.657 ANGSTROMS, C = 5.902 ANGSTROMS
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SYDNEY, 1963) 2ND EDITION, VOL. 1, P. 11.
5) SOUND VELOCITIES WERE MEASURED BY H. L. DUNEGAN (SUPPORT ENGINEERING, ULTRASONIC GROUP) UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY, BOX 808, LIVERMORE, CALIFORNIA. 94550
6) THE LONGITUDINAL AND SHEAR VELOCITIES HAVE ALSO BEEN MEASURED BY SMITH, J. F., CARLSON, C. E. AND SPEDDING, F. H., ELASTIC PROPERTIES OF YTTRIUM AND ELEVEN OF THE RARE EARTH ELEMENTS, JOURNAL OF METALS (TRANSACTIONS AIME) OCT. 1957 P. 1212. THE MEASURED VALUES ARE:
CL = 2.718 PLUS OR MINUS 0.006 KM/SEC
CS = 1.438 PLUS OR MINUS 0.013 KM/SEC.

TABLE I



73---2
NEODYMIUM

ND

VO = 0.14 CC/G   CO = 2.15 KM/SEC
VOI = 0.1427 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

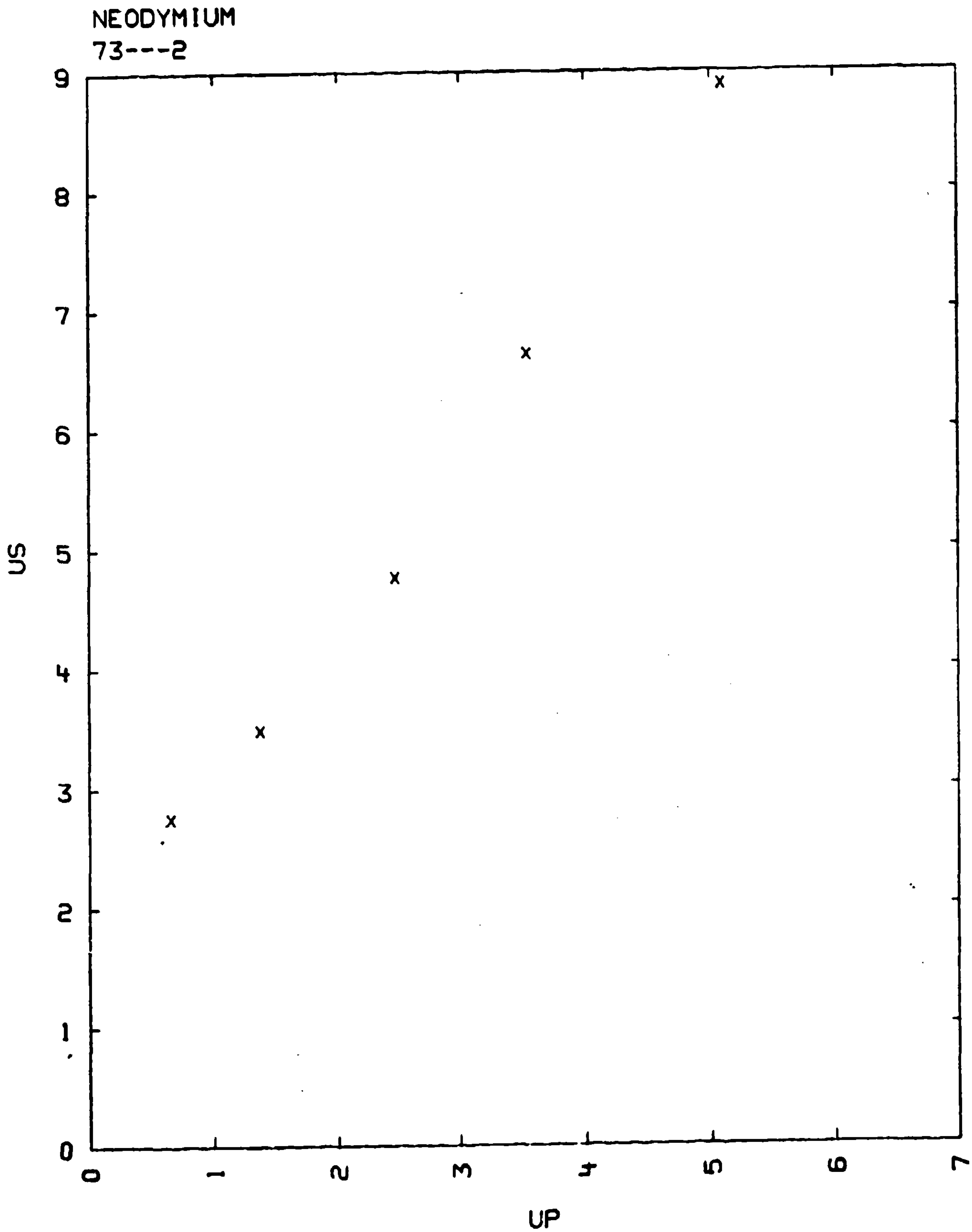
SAMPLE					STANDARD		
RHOO	US	UP	P	V/VO	MATERIAL	RHOO(ST)	US(ST)
7.0	8.88	5.09	3164.	0.427	IRON	7.85	11.21
-	6.62	3.54	1640.	0.465	IRON	7.85	8.83
-	4.76	2.48	826.	0.479	ALUMINUM	2.71	9.17
-	3.48	1.38	336.	0.604	ALUMINUM	2.71	7.34
-	2.75	0.66	127.	0.760	ALUMINUM	2.71	6.21

US = 2.08 + 1.015*UP KM/SEC FOR UP BELOW 2.07 KM/SEC
US = 0.90 + 1.585*UP KM/SEC FOR UP BETWEEN 2.07 AND 5.09 KM/SEC

COMMENTS:

1) SOURCE: ALTSHULER, L. V., BAKANOVA, A. A., DUDOLADOV, I. O.
ZHURNAL EKSP. TEORET. FIZIKI V. 53, P. 1967 (1967).
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) ONLY SHOCK VELOCITIES WERE MEASURED TO DETERMINE THE STRESS STATES. THE UNCERTAINTY IN THE SHOCK VELOCITIES WAS ESTIMATED TO BE 1.0 PERCENT.
4) HUGONIOTS OF STANDARD MATERIALS USED WERE AS FOLLOWS
ALUMINUM US = 5.25 + 1.39*UP FOR UP BETWEEN 0.0 AND 6.0 KM/SEC
IRON US = 3.85 + 1.615*UP FOR UP BETWEEN 1.0 AND 4.6 KM/SEC
5) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF THE HEXAGONAL CLOSE-PACKED STRUCTURE,
A= 3.657 ANGSTROMS, C = 5.902 ANGSTROMS
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SIDNEY, 1963) 2ND EDITION, VOL. 1, P. 11.
6) THE AUTHORS OBTAINED THE VALUE OF CO FROM HANDBOOK OF RARE METALS, (MIR PUBLISHERS, USSR, 1963) OR FROM C. KITTEL, INTRODUCTION TO SOLID STATE PHYSICS (FIZMATGIZ, USSR, 1963).
7) THE DISCONTINUITY OF THE US VS. UP PLOT AT UP = 2.07 KM/SEC IS ATTRIBUTED TO AN ELECTRONIC PHASE CHANGE.

TABLE I



74---1
PRASEODYMIUM

PR

VO = 0.1480 CC/G CL = 2.72 KM/SEC CO = 2.11 KM/SEC
VOI = 0.1469 CC/G CS = 1.49 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

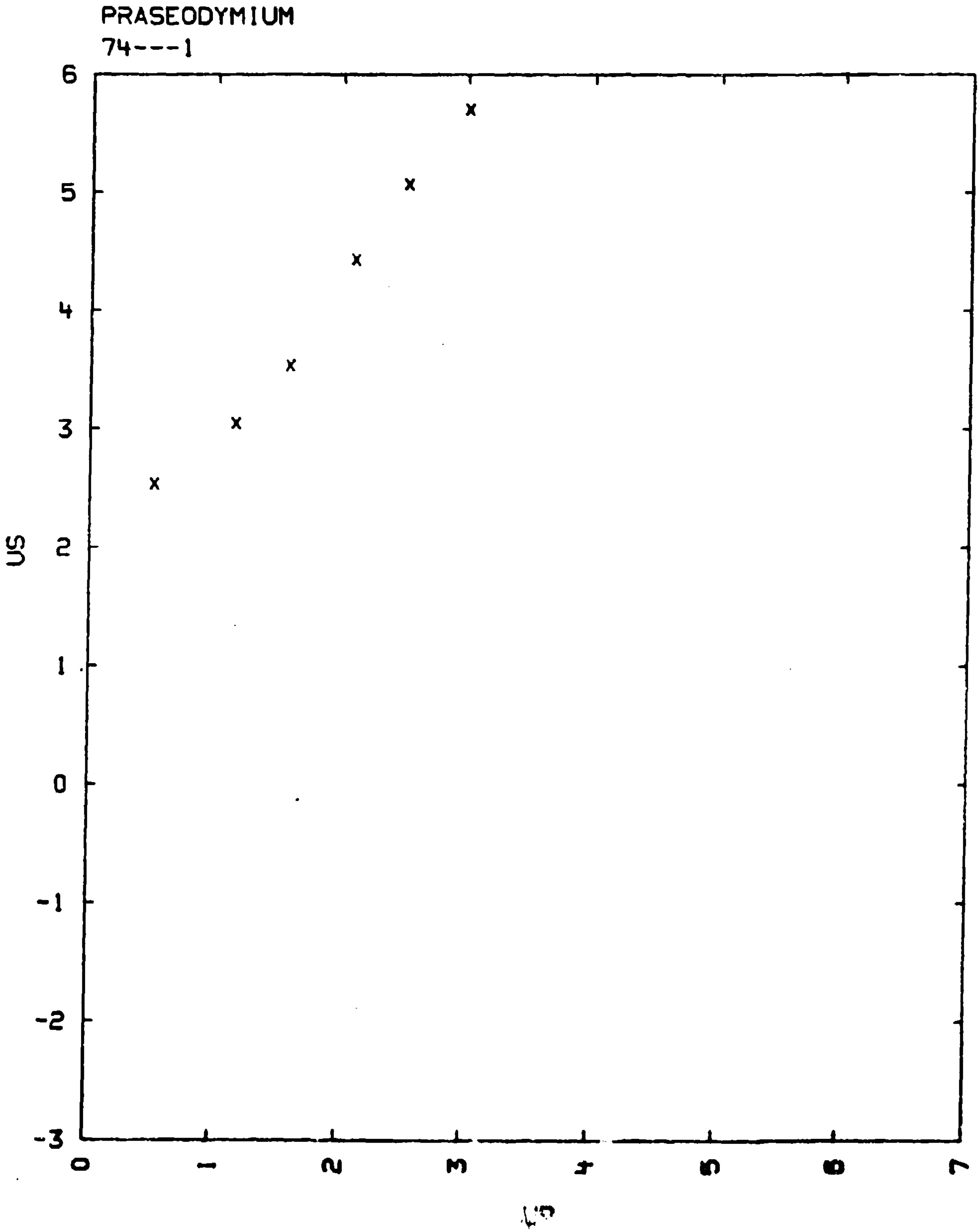
SAMPLE						STANDARD	
RHOO	US	UFS	UP	P	V/VO	MATERIAL	P
6.730	2.53	0.97	0.52	90	0.793	BRASS	149
6.754	3.53	3.02	1.59	379	0.550	BRASS	583
6.728	5.70	6.73	3.01	1153	0.473	BRASS	1570
6.776	3.04	2.11	1.16	238	0.830	ALUMINUM	233
6.769	4.43	4.30	2.11	631	0.525	ALUMINUM	542
6.772	5.06	5.04	2.53	867	0.499	ALUMINUM	730

US =

COMMENTS:

1) SOURCE: GUST, W. H.
PRIVATE COMMUNICATION
UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY,
BOX 808, LIVERMORE, CALIFORNIA. 94550
2) EXPERIMENTAL TECHNIQUE B .
DATA REDUCTION TECHNIQUE B.
3) THIS IS PRELIMINARY DATA AND FURTHER WORK IS IN PROGRESS. TAKING INTO ACCOUNT THE ACCURACY OF THE EXPERIMENTAL TECHNIQUE, THE DATA ARE BEST DESCRIBED BY MORE THAN ONE STRAIGHT LINE IN THE US VS. UP PLANE. THE SIGNIFICANCE OF THIS CHARACTERISTIC IS BEING INVESTIGATED.
4) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANT OF THE CUBIC CLOSE-PACKED STRUCTURE.
A = 5.161 ANGSTROMS
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SYDNEY, 1963) 2ND EDITION, VOL. 1, P. 10.
5) SOUND VELOCITIES WERE MEASURED BY H. L. DUNEGAN (SUPPORT ENGINEERING, ULTRASONIC GROUP) UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY, BOX 808, LIVERMORE, CALIFORNIA. 94550
6) THE LONGITUDINAL AND SHEAR VELOCITIES HAVE ALSO BEEN MEASURED BY SMITH, J. F., CARLSON, C. E. AND SPEDDING, F. H., ELASTIC PROPERTIES OF YTTRIUM AND ELEVEN OF THE RARE EARTH ELEMENTS, JOURNAL OF METALS (TRANSACTIONS AIME) OCT. 1957 P. 1212. THE MEASURED VALUES ARE:
CL = 2.660 PLUS OR MINUS 0.011 KM/SEC
CS = 1.410 PLUS OR MINUS 0.016 KM/SEC.

TABLE I



75---1
CERIUM

CE

VO = 0.1476 CC/G CL = 2.35 KM/SEC CO = 1.79 KM/SEC
VOI = 0.14773 CC/G CS = 1.32 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

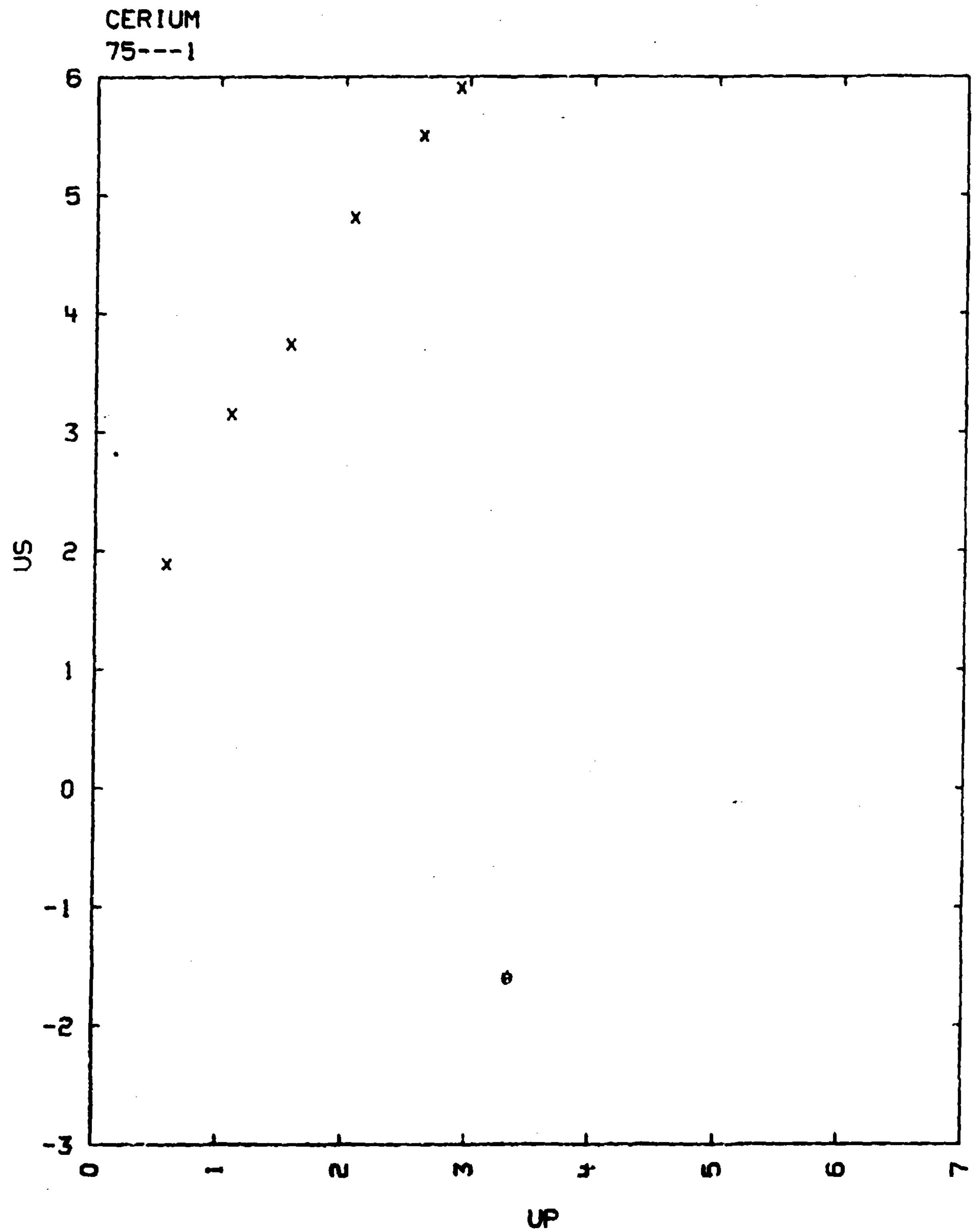
SAMPLE						-- STANDARD --	
RHOO	US	UFS	UP	P	V/VO	MATERIAL	P
6.760	1.88	1.12	0.58	73	0.694	BRASS	148
6.742	3.73	2.90	1.57	395	0.580	BRASS	597
6.753	5.90	6.02	2.93	1166	0.504	BRASS	1543
6.797	3.14	2.18	1.10	235	0.649	ALUMINUM	223
6.798	4.80	4.26	2.08	679	0.556	ALUMINUM	561
6.797	5.49	5.33	2.62	977	0.523	BRASS	1290

US =

COMMENTS:

1) SOURCE: GUST, W. H.
PRIVATE COMMUNICATION
UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY,
BOX 808, LIVERMORE, CALIFORNIA, 94550
2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION TECHNIQUE B.
3) THIS IS PRELIMINARY DATA AND FURTHER WORK IS IN PROGRESS. TAKING INTO ACCOUNT THE ACCURACY OF THE EXPERIMENTAL TECHNIQUE, THE DATA ARE BEST DESCRIBED BY MORE THAN ONE STRAIGHT LINE IN THE US VS. UP PLANE. THE SIGNIFICANCE OF THIS CHARACTERISTIC IS BEING INVESTIGATED.
4) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANT OF THE CUBIC CLOSE-PACKED STRUCTURE,
A = 5.1612 ANGSTROMS
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SYDNEY, 1963) 2ND EDITION, VOL. 1 P. 10.
5) SOUND VELOCITIES WERE MEASURED BY H. L. DUNEGAN (SUPPORT ENGINEERING, ULTRASONIC GROUP) UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY, BOX 808, LIVERMORE, CALIFORNIA, 94550
6) THE LONGITUDINAL AND SHEAR VELOCITIES HAVE ALSO BEEN MEASURED BY SMITH, J. F., CARLSON, C. E. AND SPEDDING, F. H., ELASTIC PROPERTIES OF YTTRIUM AND ELEVEN OF THE RARE EARTH ELEMENTS, JOURNAL OF METALS (TRANSACTIONS AIME) OCT. 1957 P. 1212. THE MEASURED VALUES ARE:
CL = 2.300 PLUS OR MINUS 0.020 KM/SEC
CS = 1.332 PLUS OR MINUS 0.011 KM/SEC.

TABLE I



75---2
CERIUM

CE

VO = 0.148 CC/G
VOI = 0.14773 CC/G

CO = 1.71 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

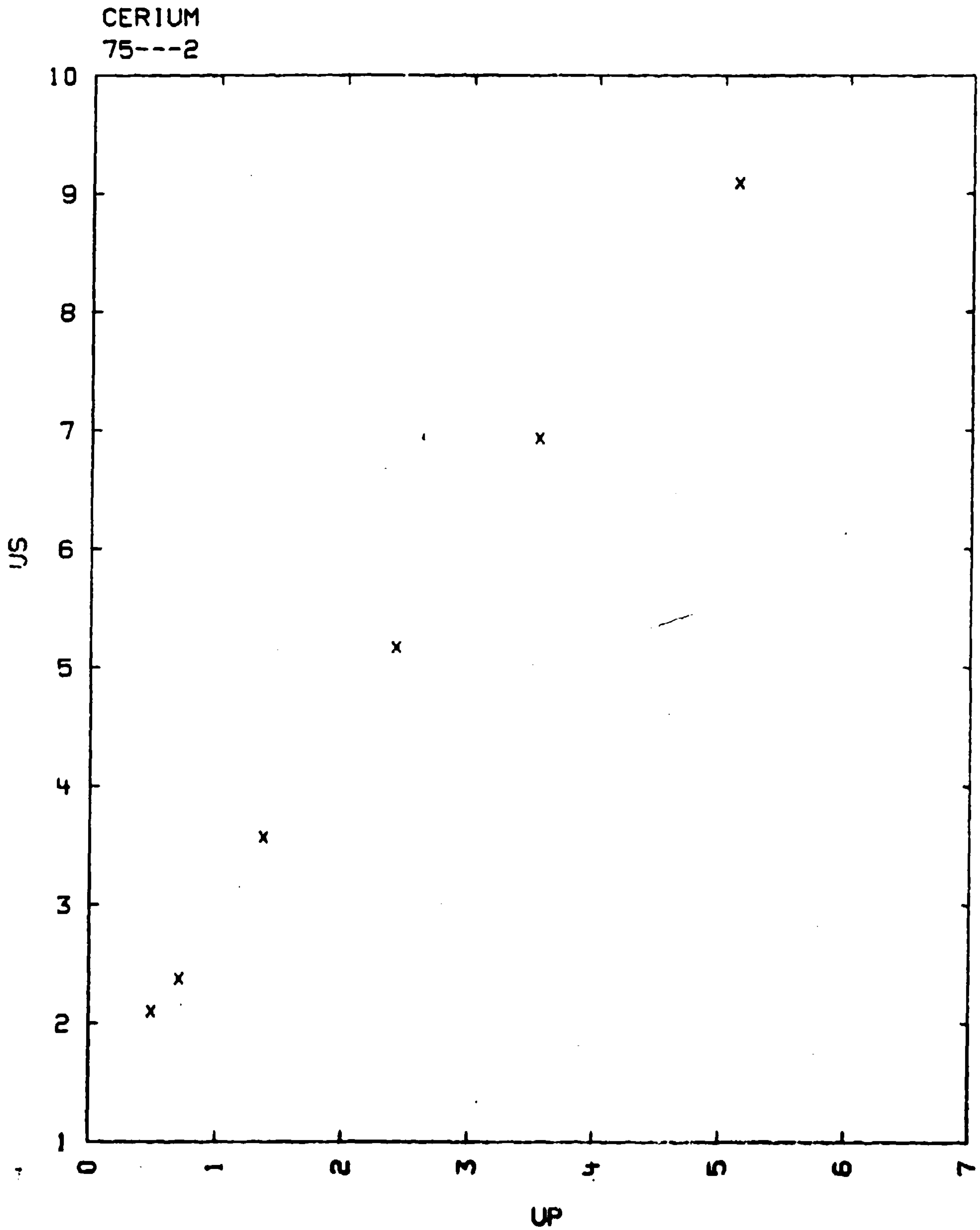
SAMPLE					STANDARD		
RHOO	US	UP	P	V/VO	MATERIAL	RHOO(ST)	US(ST)
6.75	9.08	5.12	3133.	0.436	IRON	7.85	11.21
-	6.93	3.54	1656.	0.489	IRON	7.85	8.83
-	5.17	2.42	845.	0.532	ALUMINUM	2.71	9.17
-	3.56	1.38	332.	0.612	ALUMINUM	2.71	7.34
-	2.37	0.71	113.6	0.700	ALUMINUM	2.71	6.21
-	2.10	0.50	70.8	0.762			

US = 1.27 + 1.596*UP KM/SEC FOR UP BETWEEN 0.7 AND 5.12 KM/SEC

COMMENTS:

1) SOURCE: ALTSHULER, L. V., BAKANOVA, A. A., DUDOLADOV, I. P.
ZHURNAL EKSP. TEORET. FIZIKI V. 53, P. 1967 (1967).
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) ONLY SHOCK VELOCITIES WERE MEASURED TO DETERMINE THE STRESS STATES. THE UNCERTAINTY IN THE SHOCK VELOCITIES WAS ESTIMATED TO BE 1.0 PERCENT.
4) HUGONIOTS OF STANDARD MATERIALS USED WERE AS FOLLOWS
ALUMINUM US = 5.25 + 1.39*UP FOR UP BETWEEN 0.0 AND 6.0 KM/SEC
IRON US = 3.85 + 1.815*UP FOR UP BETWEEN 1.0 AND 4.6 KM/SEC
5) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANT OF THE CUBIC CLOSE-PACKED STRUCTURE,
A = 5.1612 ANGSTROMS
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SIDNEY, 1963) 2ND EDITION, VOL. 1, P. 10.
6) THE AUTHORS OBTAINED THE VALUE OF CO FROM HANDBOOK OF RARE METALS, (MIR PUBLISHERS, USSR, 1963) OR FROM C. KITTEL, INTRODUCTION TO SOLID STATE PHYSICS (FIZMATGIZ, USSR, 1963).

TABLE I



76---1
LANTHANUM

LA

VO = 0.1634 CC/G   CL = 2.77 KM/SEC   CO = 2.13 KM/SEC
VOI = 0.160 CC/G   CS = 1.53 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

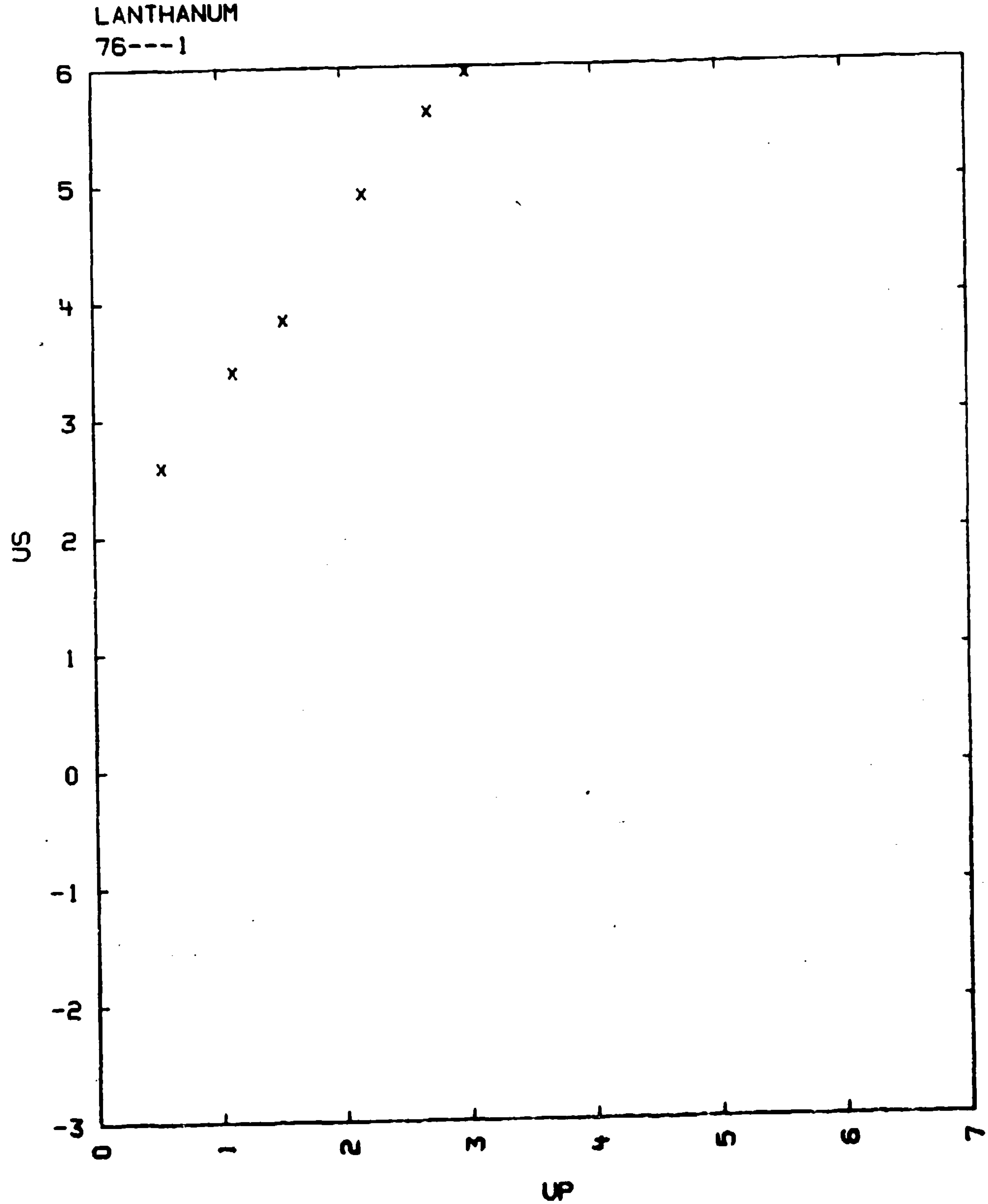
SAMPLE						STANDARD	
RHOO	US	UFS	UP	P	V/VO	MATERIAL	P
6.148	2.59	0.97	0.54	87	0.790	BRASS	131
6.147	3.84	2.98	1.53	361	0.602	BRASS	553
6.135	5.95	6.09	3.00	1093	0.497	BRASS	1530
6.094	3.39	2.27	1.12	232	0.668	ALUMINUM	223
6.091	4.90	4.45	2.17	648	0.557	ALUMINUM	561
6.098	5.61		2.70	923	0.520	BRASS	1290

US =

COMMENTS:

1) SOURCE: GUST, W. H.
PRIVATE COMMUNICATION
UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY, BOX 808, LIVERMORE, CALIFORNIA, 94550
2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION TECHNIQUE B.
3) THIS IS PRELIMINARY DATA AND FURTHER WORK IS IN PROGRESS. TAKING INTO ACCOUNT THE ACCURACY OF THE EXPERIMENTAL TECHNIQUE, THE DATA ARE BEST DESCRIBED BY MORE THAN ONE STRAIGHT LINE IN THE US VS. UP PLANE. THE SIGNIFICANCE OF THIS CHARACTERISTIC IS BEING INVESTIGATED.
4) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANT OF THE CUBIC CLOSE-PACKED STRUCTURE,
A = 5.296 ANGSTROMS
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SYDNEY, 1963) 2ND EDITION, VOL. 1, P. 10.
5) SOUND VELOCITIES WERE MEASURED BY H. L. DUNEGAN (SUPPORT ENGINEERING, ULTRASONIC GROUP) UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY, BOX 808, LIVERMORE, CALIFORNIA, 94550
6) THE LONGITUDINAL AND SHEAR VELOCITIES HAVE ALSO BEEN MEASURED BY SMITH, J. F., CARLSON, C. E. AND SPEDDING, F. H., ELASTIC PROPERTIES OF YTTRIUM AND ELEVEN OF THE RARE EARTH ELEMENTS, JOURNAL OF METALS (TRANSACTIONS AIME) OCT. 1957 P. 1212. THE MEASURED VALUES ARE:
CL = 2.751 PLUS OR MINUS 0.008 KM/SEC
CS = 1.501 PLUS OR MINUS 0.002 KM/SEC.

TABLE I



76---2
LANTHANUM

LA

VO = 0.163 CC/G
VO' = 0.160 CC/G

CO = 2.22 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

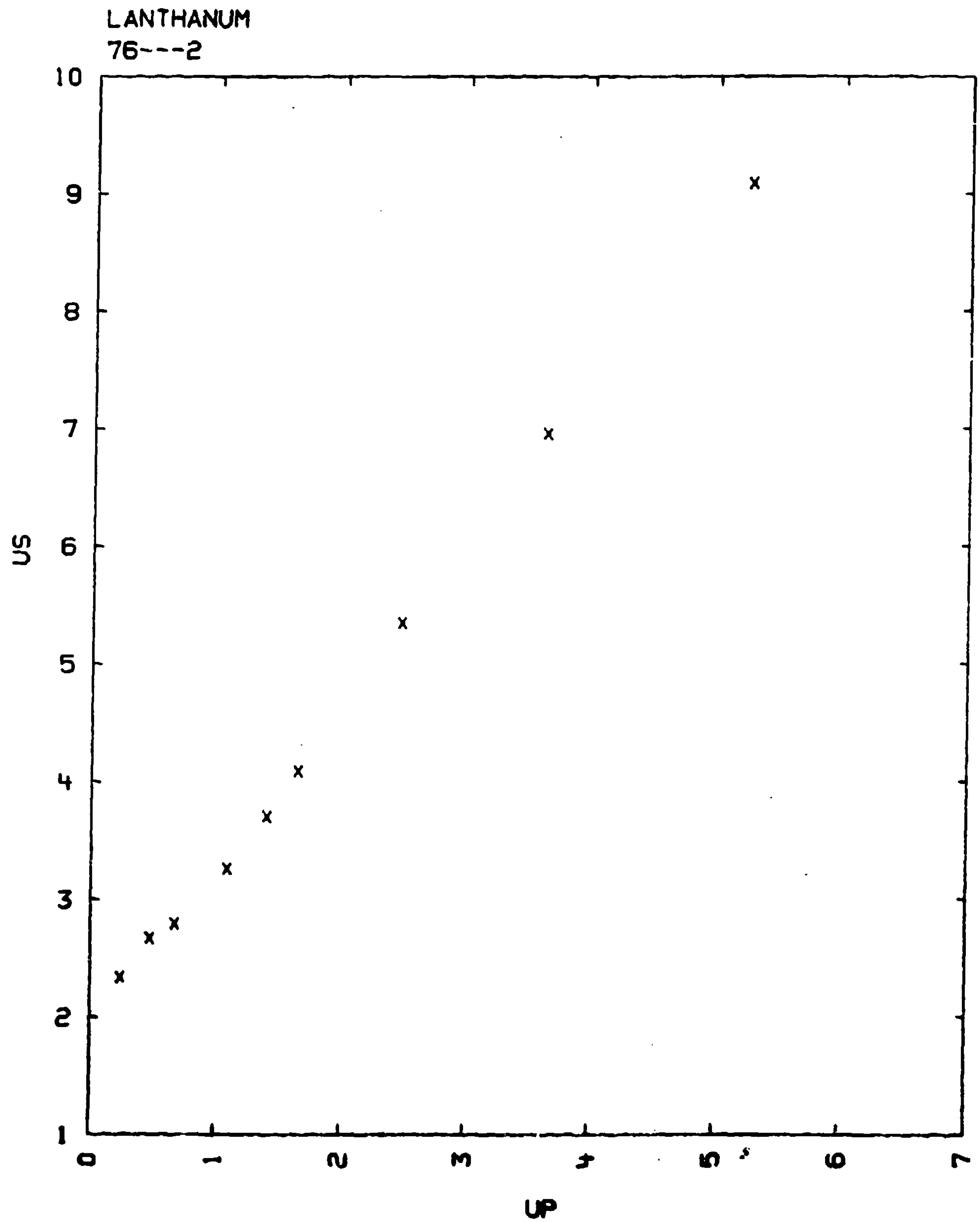
SAMPLE					STANDARD		
RHOO	US	UP	P	V/VO	MATERIAL	RHOO(ST)	US(ST)
6.15	9.09	5.27	2946.	0.420	IRON	7.85	11.21
-	6.95	3.65	1560.	0.475	IRON	7.85	8.83
-	5.35	2.49	820.	0.534	ALUMINUM	2.71	9.17
-	4.08	1.66	417.	0.593			
-	3.70	1.41	321.	0.619	ALUMINUM	2.71	7.34
-	3.26	1.10	221.	0.663			
-	2.79	0.68	117.	0.756	ALUMINUM	2.71	6.21
-	2.67	0.48	79.	0.820			
-	2.34	0.24	34.	0.898			

US = 2.16 + 1.0*UP KM/SEC FOR UP BELOW 1.11 KM/SEC
US = 1.65 + 1.46*UP KM/SEC FOR UP BETWEEN 1.11 AND 4.0 KM/SEC

COMMENTS:

1) SOURCE: ALTSHULER, L. V., BAKANOVA, A. A., DUDOLADOV, I. P.
ZHURNAL EKSP. TEORET. FIZIKI V. 53, P. 1967 (1967).
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) ONLY SHOCK VELOCITIES WERE MEASURED TO DETERMINE THE STRESS STATES. THE UNCERTAINTY IN THE SHOCK VELOCITIES WAS ESTIMATED TO BE 1.0 PERCENT.
4) HUGONIOTS OF STANDARD MATERIALS USED WERE AS FOLLOWS
ALUMINUM US = 5.25 + 1.39*UP FOR UP BETWEEN 0.0 AND 6.0 KM/SEC
IRON US = 3.85 + 1.615*UP FOR UP BETWEEN 1.0 AND 4.6 KM/SEC
5) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANT OF THE CUBIC CLOSE-PACKED STRUCTURE.
A = 5.296 ANGSTROMS
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SIDNEY, 1963) 2ND EDITION, VOL. 1, P. 10.
6) THE AUTHORS OBTAINED THE VALUE OF CO FROM HANDBOOK OF RARE METALS, (MIR PUBLISHERS, USSR, 1963) OR FROM C. KITTEL, INTRODUCTION TO SOLID STATE PHYSICS (FIZMATGIZ, USSR, 1963).
7) THE DISCONTINUITY OF THE US VS. UP PLOT AT UP = 1.11 KM/SEC IS ATTRIBUTED TO AN ELECTRONIC PHASE CHANGE.

TABLE I



88---0
URANIUM SUMMARY

U

VO = 0.0533 - 0.0525 CC/G
VOI= 0.05249 CC/G

THE TABLE LISTS HUGONIOT POINTS CALCULATED FROM THE FITS GIVEN BELOW.
UNITS ARE: G/CC, KM/SEC, KBAR AND KBAR.CC/G FOR THE ENERGY DIFFERENCE.
EL = ELASTIC LIMIT.

TABLE

FIT	RHOO	US	UP	P	V/VO	E-EO	COMMENTS
	18.80	3.45	0.0025	1.6	0.9993	0.000031	EL 1ST WAVE
1	-	2.610	0.1	49.4	0.9619	0.0475	2ND -
	-	2.941	0.3	166.	0.8981	0.442	- -
	-	3.272	0.5	307.	0.8473	1.24	- -
	-	3.603	0.7	474.	0.806	2.45	1ST -
	-	3.653	0.73	501.	0.800	2.66	- -
2	-	3.694	0.80	556.	0.783	3.2	- -
	-	4.013	1.0	754.	0.751	5.0	- -
	-	5.606	2.0	2108.	0.643	20.0	- -
	-	7.199	3.0	4060.	0.583	45.0	- -
	-	8.792	4.0	6612.	0.545	80.00	- -
3	9.5	1.828	1.0	173.	0.453	5.0	- -
	-	3.563	2.0	677.	0.439	20.0	- -
	-	5.185	3.0	1478.	0.421	45.0	- -
	-	6.694	4.0	2543.	0.402	80.0	- -
	-	8.091	5.0	3843.	0.382	125.0	- -

US = 2.445 + 1.655*UP, SIG.US = 0.07 KM/SEC FIT 1
FOR UP BETWEEN 0.13 AND .74 KM/SEC.
US = 2.420 + 1.593*UP, SIG.US = 0.08 KM/SEC FIT 2
FOR UP BETWEEN 0.8 AND 4. KM/SEC
US = 2.483 + 1.579*UP - 0.262(19.05 - RHOO) + FIT 3
+ 0.034(19.05 - RHOO)*UP - 0.0059*(19.05-RHOO)*UP**2.
SIG.US= 0.16 KM/SEC OVER ALL
BUT SIG.US= 0.3 AT RHOO = 9.5 G/CC
FOR UP BETWEEN 1 AND 5 AND RHOO FROM 19.05 TO 9.5 G/CC

COMMENTS:

1) SOURCE: COMPILER
1A) DATA FROM 88---1,2,3,4 AND 5 WERE USED FOR THESE FITS.
2) THE ELASTIC LIMIT WAS TAKEN FROM 88---5.
3) THE DUAL FIT, 1 AND 2 WERE MADE IN LINE WITH THE TRANSITION SUGGES-
TED BY DATA OF 88---4.
4) THIS TRANSITION HAS BEEN IGNORED IN GENERATING FIT 3 WHICH INCLUDES

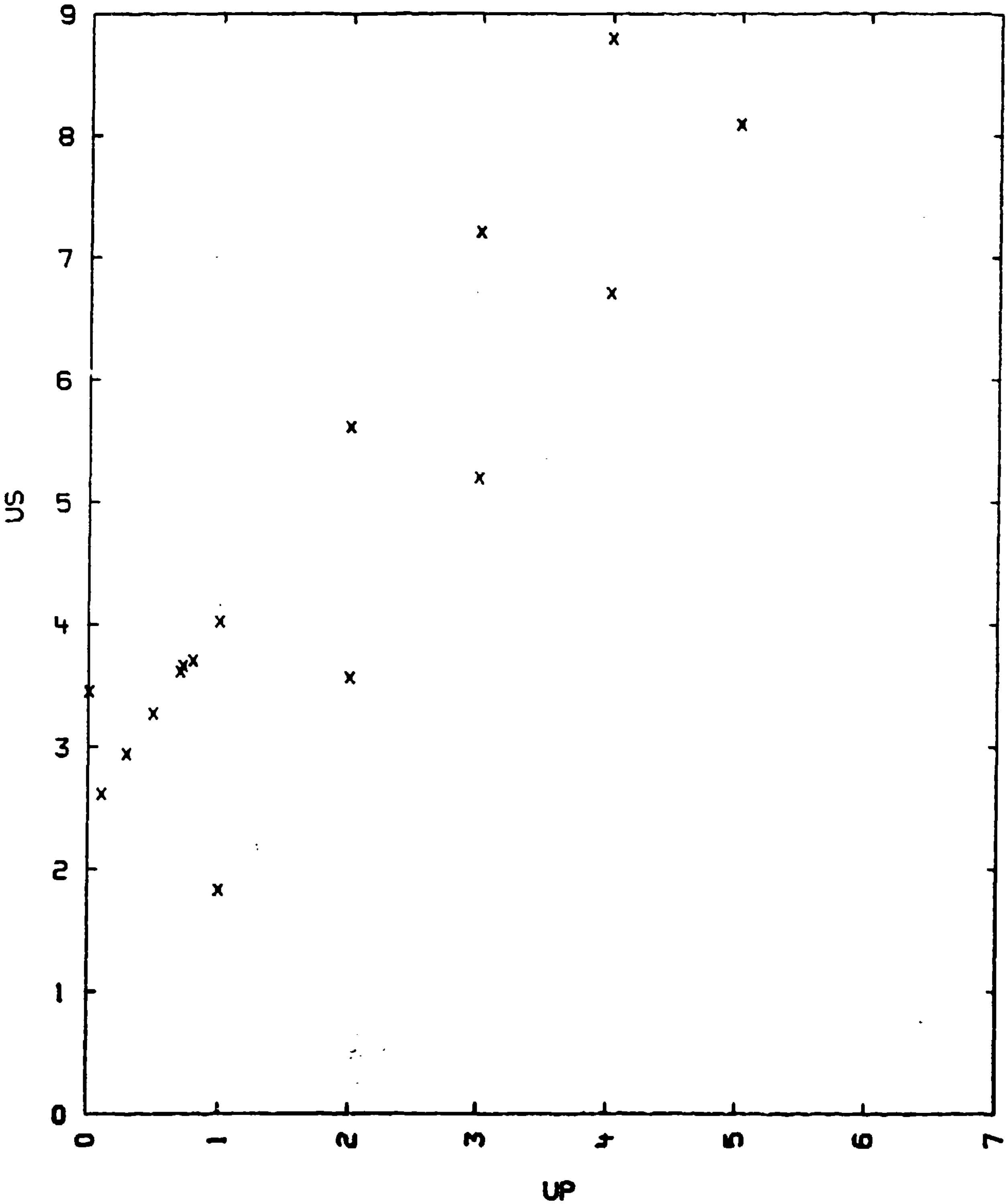
POROUS DATA, SINCE THE LATTER ARE INSUFFICIENTLY ACCURATE TO SHOW THE TRANSITION. MOST OF THE UNCERTAINTY IN THIS FIT IS DUE TO THE POROUS URANIUM DATA WHICH SHOW A MAXIMUM DEVIATION

US - US(CALC) = 0.7 KM/SEC

AND AN RMS VALUE OF 0.3 KM/SEC.

TABLE I

URANIUM SUMMARY
88---0



88---1
URANIUM POROUS

URANIUM U 96 PERCENT
URANIUM OXIDE U-02 4 PERCENT

VO = .116 (+OR-) .005 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN MM/MICRO-SEC, AND PRESSURE IN KILOBARS.

TABLE

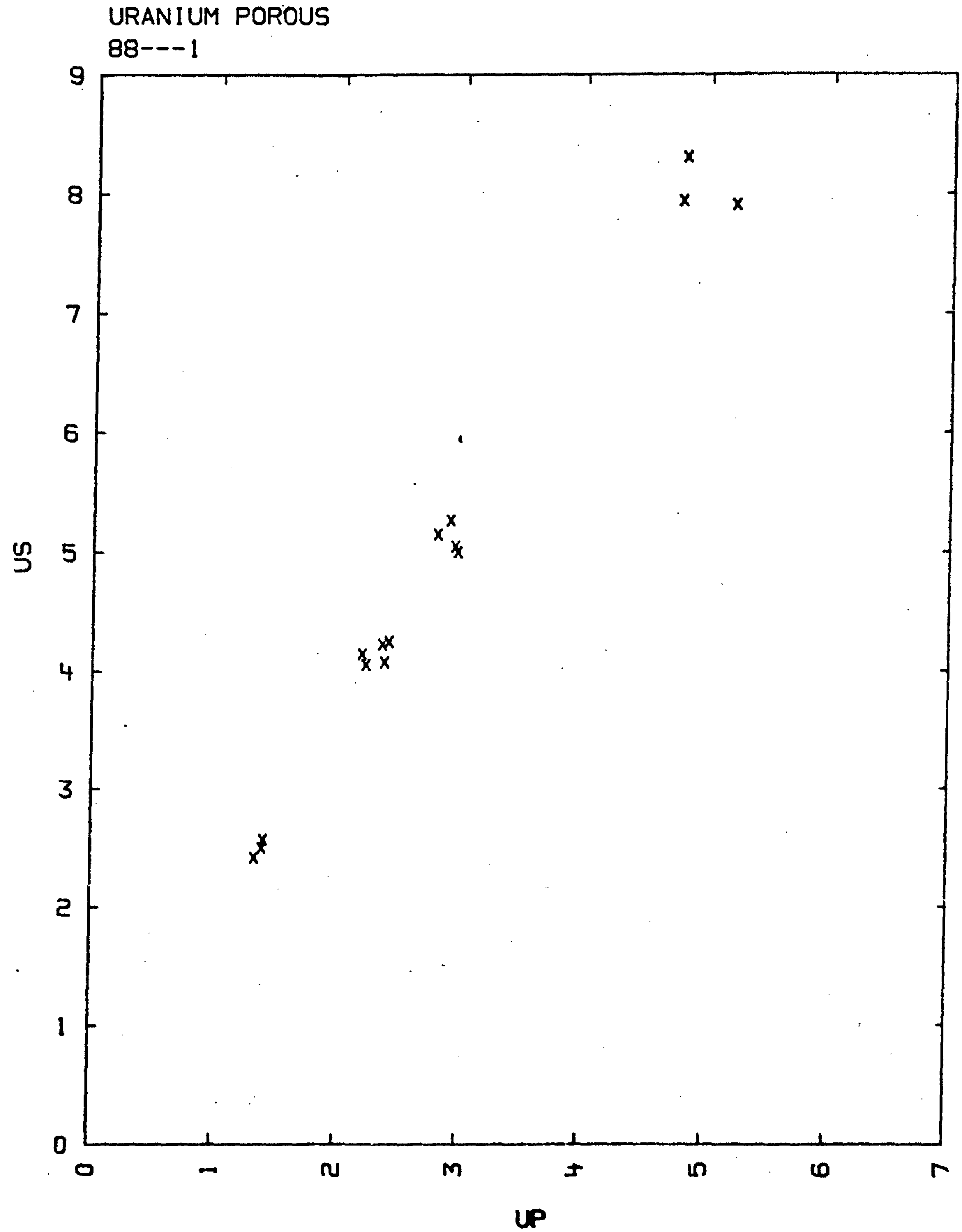
RHOO	US	UP	P	V/VO
9.5	2.41	1.34	307	.883
-	2.56	1.41	343	.893
-	2.50	1.40	333	.877
-	4.05	2.23	858	.993
-	4.14	2.20	866	.933
-	4.07	2.38	919	.825
-	4.22	2.36	946	.875
-	4.24	2.41	970	.857
-	5.14	2.80	1370	.905
-	5.00	2.97	1390	.794
-	5.04	2.95	1400	.814
-	5.26	2.90	1450	.891
-	7.94	4.77	3600	.794
-	8.30	4.80	3790	.839
-	7.90	5.20	3900	.676

US = 1.869*UP - 0.047*UP**2. KM/SEC

COMMENTS:

1) SOURCE: SKIDMORE, I.C. AND MORRIS, E.
THERMODYNAMICS OF NUCLEAR MATERIALS, P. 173 FF. (1962)
INTERN. AT. ENERGY AGENCY, VIENNA
ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON, ENGLAND
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE B
THE SHOCK WAS PRODUCED BY AN EXPLOSIVELY ACCELERATED EN3 STEEL PLATE.
THE SHOCK WAS TRANSMITTED THROUGH A STEEL PLATE INTO THE SAMPLE.
3) THE VELOCITY OF THE FLYING PLATE AND THE SHOCK AND SURFACE VELOCITY OF THE TARGET PLATE WERE MEASURED AS WELL AS THE SAMPLE SURFACE AND SHOCK VELOCITIES.
4) DATA SCATTER WAS ABOUT 0.03 MICROSEC.
5) CORRECTIONS WERE MADE FOR FLYING PLATE CURVATURE OF UP TO 1 MICROSEC.
6) THE HIGHER PRESSURES WERE OBTAINED BY A SPHERICALLY CONVERGING SYSTEM.
7) ALL PELLETS WERE SURROUNDED BY LEAD TO REDUCE LATERAL RAREFACTION.

TABLE I



88---2
URANIUM

U

VO = .05295 CC/G
VOI = .05249 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN MM/MICRO-SEC, AND PRESSURE IN KILOBARS.

TABLE

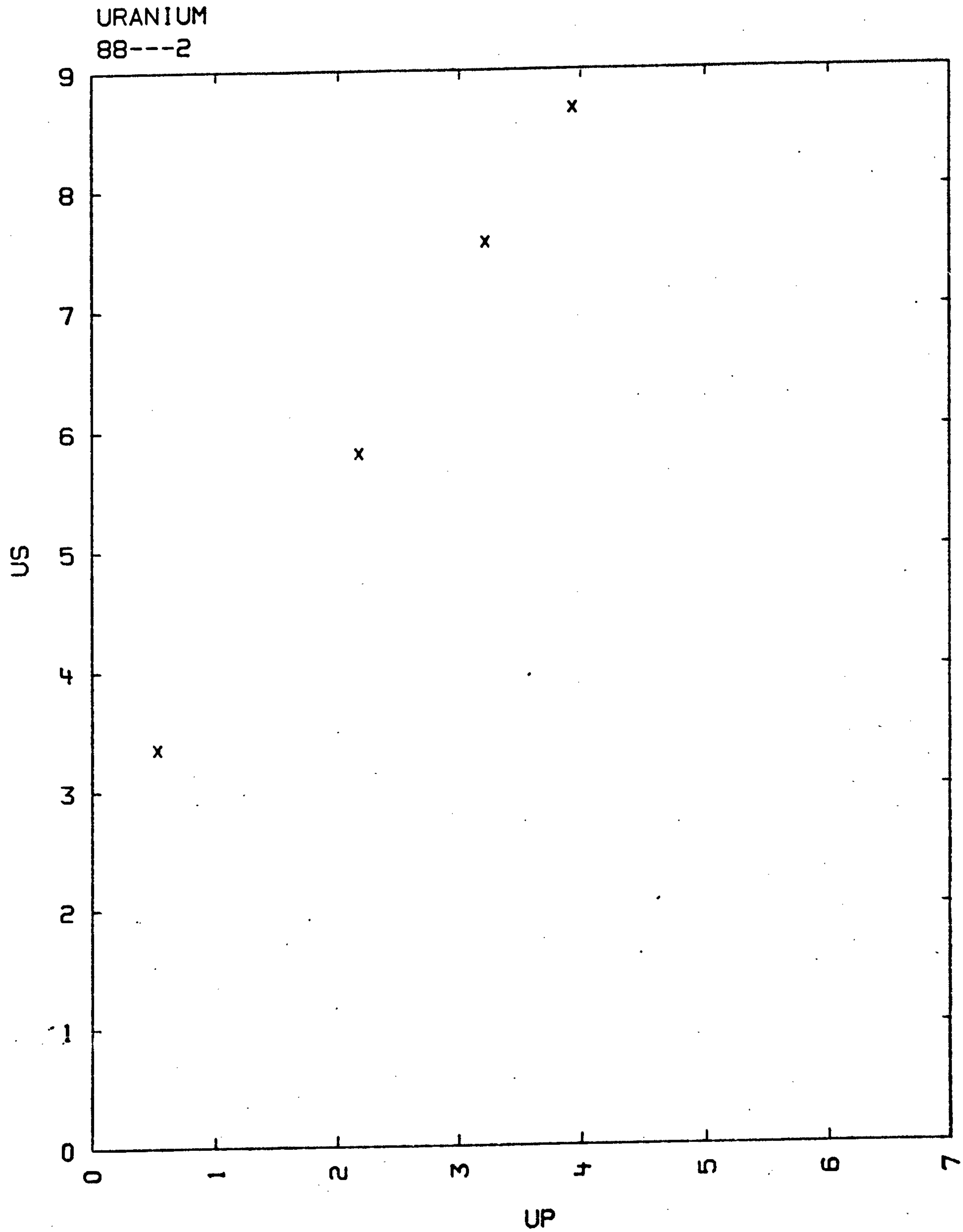
RHOO	US	UP	P	V/VO
18.85	3.35	.53	335	.842
18.9	5.80	2.17	2380	.626
18.9	7.55	3.22	4470	.562
18.9	8.66	3.94	6450	.545

US = 2.55 +1.504UP + 0.0901(UP - 2.50)**2 MM/MICROSEC FOR UP GREATER THAN 2.50
US = 2.55 + 1.504UP MM/MICROSEC FOR UP LESS THAN 2.50

COMMENTS:

1) SOURCE: SKIDMORE, I.C. AND MORRIS, E.
THERMODYNAMICS OF NUCLEAR MATERIALS, P. 173 FF. (1962)
INTERN. AT. ENERGY AGENCY, VIENNA
ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON, ENGLAND
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE B
ALL SAMPLES WERE POSITIONED ON A TARGET PLATE OF STEEL (MTRL. 41---2) AND THE PRESSURE WAS PRODUCED BY AN EXPLOSIVELY ACCELERATED PLATE OF STEEL.
3) THE VELOCITY OF THE FLYING PLATE AND THE SHOCK AND SURFACE VELOCITY OF THE TARGET PLATE WERE MEASURED AS WELL AS THE SAMPLE SURFACE AND SHOCK VELOCITIES.
4) DATA SCATTER WAS ABOUT 0.03 MICROSEC
5) CORRECTIONS WERE MADE FOR FLYING PLATE CURVATURE OF UP TO 1 MICROSEC.
6) THE HIGHER PRESSURES WERE OBTAINED BY A SPHERICALLY CONVERGING SYSTEM.

TABLE I



88---3
URANIUM

U

VO = 0.0531 CC/G
VOI = 0.05249 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN KM/SEC AND PRESSURE IN KILOBARS.

TABLE

SAMPLE					BASE PLATE		PROJECTILE
RHOO	US	UP	P	V/VO	MATERIAL	UFS	VELOCITY
18.76	3.66	0.520	355	0.858	BRASS	1.365	
18.76	3.62	0.528	356	0.854	BRASS	1.373	
18.76	3.61	0.544	362	0.849	BRASS	1.391	
18.76	3.60	0.760	515	0.789	BRASS		
18.76	3.85	0.837	602	0.783	DURAL	3.415	
18.76	3.94	0.773	570	0.804	DURAL	3.250	
18.76	3.83	0.790	570	0.794	DURAL	3.270	
18.76	3.80	0.755	532	0.801	BRASS	1.905	
18.76	3.77	0.762	525	0.798	BRASS	1.883	
18.76	4.59	1.33	1150	0.710			3.35
18.76	4.59	1.34	1150	0.708			3.36
18.76	4.58	1.33	1140	0.710			3.35
19.00	4.48	1.33	1130	0.703			3.33
19.00	4.53	1.37	1180	0.698			3.43
19.00	4.56	1.35	1170	0.704			3.40
18.76	5.20	1.68	1670	0.677			4.29
18.76	5.24	1.71	1680	0.674			4.34
19.00	5.16	1.69	1660	0.672			4.30
19.00	5.19	1.69	1620	0.674			4.25
19.00	5.18	1.70	1630	0.672			4.28

US = 2.77 + 1.39 UP KM/SEC
SIGMA US = 0.105 KM/SEC

COMMENTS:

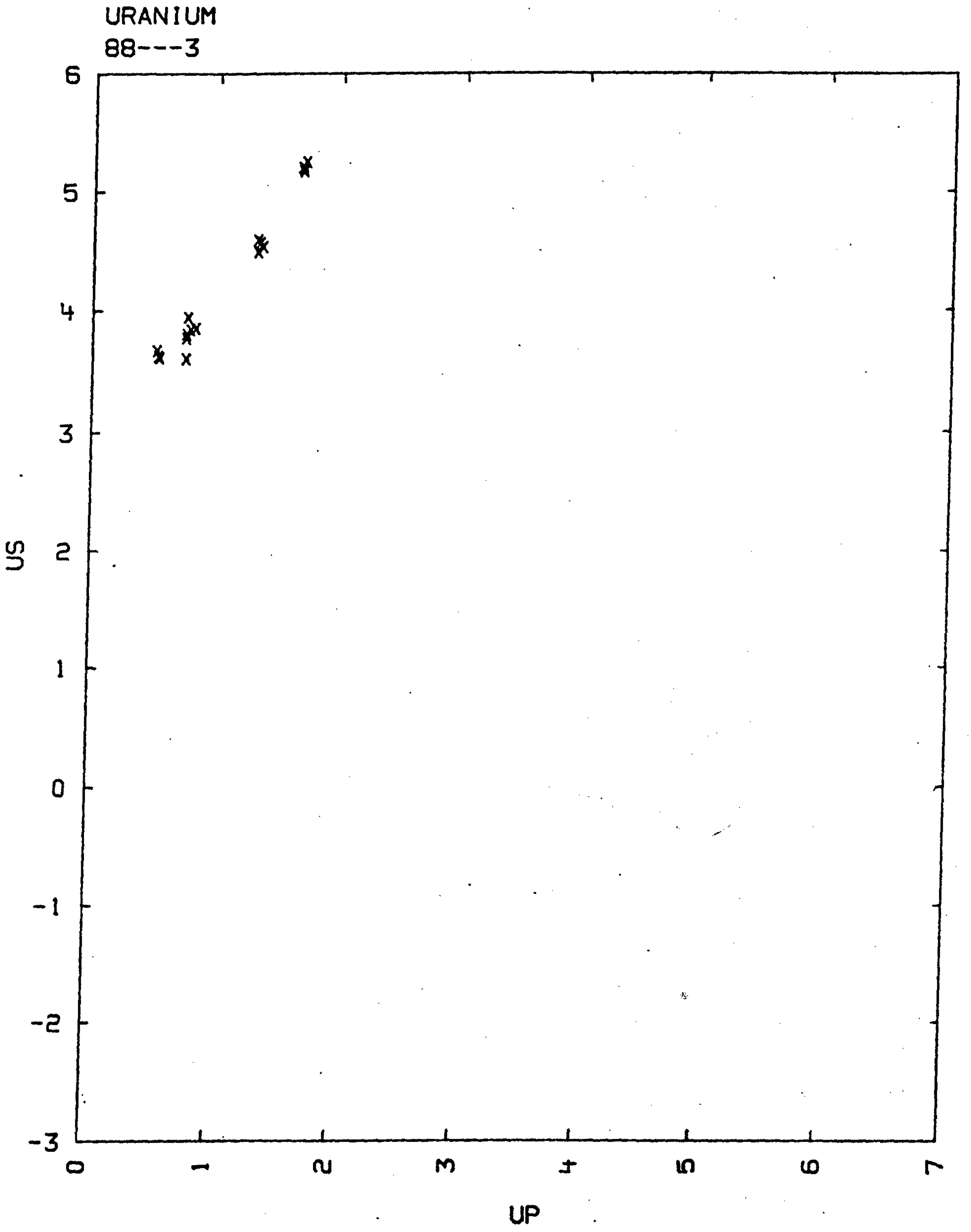
1) SOURCE: PERSSON, P.A. AND PERSSON, I.
FOA 2 REPORT A 2299-222, SEPT. 1964,
FORSVARETS FORSKNINGSANSTALT AVDELNING, SWEDEN.
UCRL TRANSLATION 1173(L).
2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION TECHNIQUE B.
3) IN THE EXPERIMENTS USING FLYING PLATE PROJECTILES BOTH THE BASE PLATE AND PROJECTILE WERE MADE OF SVENSKA METALLWERKEN ALLOY 1163 WITH COMPOSITION CU/ZN/PB = 63.0/36.6/0.4, RHO = 8.48 G/CC
CALIBRATION EXPERIMENTS OF THIS ALLOY AGREED TO 1 PERCENT WITH DATA BY R. G. MCQUEEN AND S. P. MARSH, J. APPL. PHYS., VOL 31 P 1253

(1960).

4) THE ALUMINUM ALLOY USED FOR BASE PLATES HAD A COMPOSITION AL/CU/MG/MN/SI=93.6/4.5/0.6/0.8/0.7 AND IT WAS ASSUMED WITHOUT CHECKING TO HAVE THE SAME HUGONIOT AS REPORTED BY M. H. RICE ET AL. SOLID STATE PHYSICS, VOL. 16, P 1, (1958).

5) THE VALUE OF VOI WAS OBTAINED FROM A. TAYLOR AND BRENDA J. KAGLE, CRYSTALLOGRAPHIC DATA ON METAL AND ALLOY STRUCTURES (DOVER PUBLICATIONS, INC., NEW YORK, N. Y., 1963).

TABLE I



88---4
URANIUM

U

VO = 0.5283 - 0.5249 CC/G
VOI = 0.5249 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN KM/SEC AND PRESSURE IN KILOBARS.

TABLE

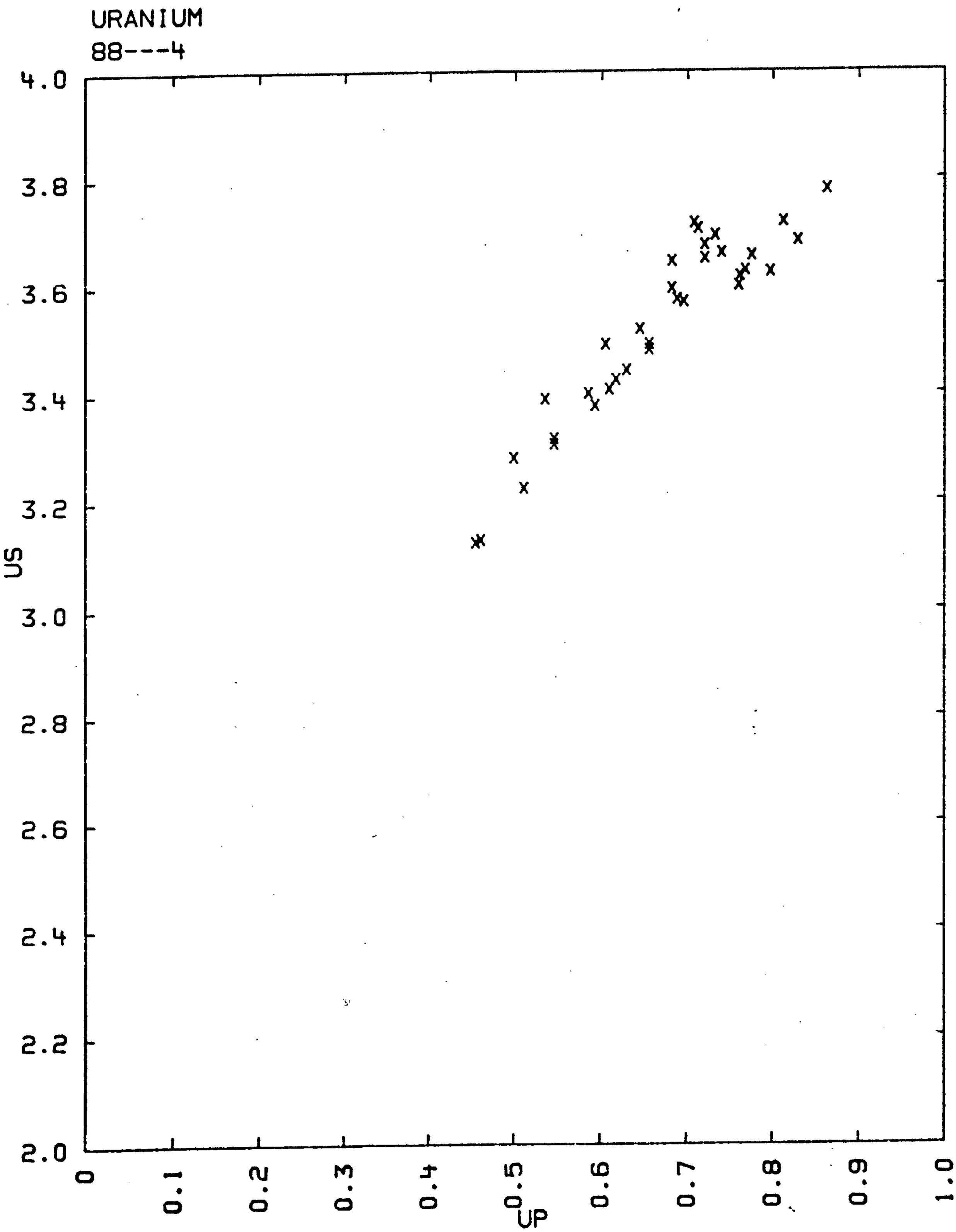
RHOO	US	UP	P	V/VO
19.05	3.124	0.4525	269	0.855
-	3.131	0.460	274	0.853
-	3.2825	0.4975	312	0.848
-	3.225	0.510	313	0.842
-	3.308	0.545	344	0.835
-	3.317	0.546	345	0.835
-	3.390	0.535	345	0.842
-	3.400	0.585	379	0.828
-	3.3775	0.5925	381	0.824
-	3.408	0.610	396	0.821
-	3.490	0.605	402	0.827
-	3.425	0.6175	403	0.820
-	3.442	0.630	412	0.817
-	3.520	0.645	432	0.817
-	3.480	0.655	433	0.812
-	3.490	0.655	435	0.812
-	3.595	0.6825	466	0.810
-	3.575	0.6875	468	0.808
-	3.570	0.695	472	0.805
-	3.645	0.682	473	0.813
-	3.650	0.720	500	0.8025
-	3.715	0.708	501	0.809
-	3.705	0.7125	502.5	0.808
-	3.675	0.720	504	0.804
-	3.693	0.7325	514	0.802
-	3.660	0.740	515	0.798
-	3.601	0.760	521	0.789
-	3.618	0.762	525	0.789
-	3.627	0.767	530	0.789
-	3.655	0.775	539	0.788
-	3.624	0.7975	551	0.780
-	3.718	0.8125	575	0.781
-	3.682	0.829	581	0.775
-	3.779	0.8625	621	0.771

US = 2.317 + 1.85 UP KM/SEC FOR UP BETWEEN 0.0 AND 0.720 KM/SEC.
US = 2.317 + 1.66 UP KM/SEC FOR UP FROM 0.800 KM/SEC

COMMENTS:

1) SOURCE: VIARD, J.
LES ONDES DE DETONATION. PP. 383-389
EDITIONS DU CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE
15, QUAI ANATOLE-FRANCE, PARIS (1962)
2) EXPERIMENTAL TECHNIQUE B.
DATA REDUCTION TECHNIQUE B.
3) THE FREE SURFACE VELOCITY MEASUREMENTS WERE NOT USED BECAUSE OF RELATIVELY HIGH UNCERTAINTIES IN TIME AND DISTANCE MEASUREMENTS.
   A) THE UFS FOR URANIUM IS VERY LOW, THUS THE FREE SURFACE VELOCITY HAS TO BE MEASURED OVER A VERY SHORT DISTANCE.
   B) THE FREE SURFACE IN URANIUM IS PRECEDED BY A CLOUD OF URANIUM OF LOW DENSITY THAT PROPAGATES WITH A MUCH HIGHER VELOCITY THAN THE FREE SURFACE VELOCITY.
4) THE INITIAL DENSITY VARIED FROM 18.93-19.05 G/CC.
5) A PHASE TRANSITION IS OBSERVED AT 505 KILOBARS.
6) THE VALUE OF VOI WAS OBTAINED FROM CRYSTALLOGRAPHIC DATA ON METAL AND ALLOY STRUCTURES BY A. TAYLOR AND BRENDA J. KAGLE
DOVER PUBLICATIONS, INC. NEW YORK, N. Y. (1963).

TABLE I


URANIUM
88---4
US
UP
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

88---5
URANIUM

U

VOI = 0.05294 CC/G.

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC., VELOCITIES IN KM/SEC., AND PRESSURE IN KILOBARS. CL IS THE LONGITUDINAL VELOCITY BEHIND THE SHOCK-FRONT. X DESIGNATES THE SHOCK THICKNESS GIVEN IN MICROSECONDS. U(PRO) DESIGNATES THE PROJECTILE VELOCITY AT IMPACT. A WEAK PRECURSOR PRECEDES THE MAIN WAVE. SEE COMMENT 3

TABLE

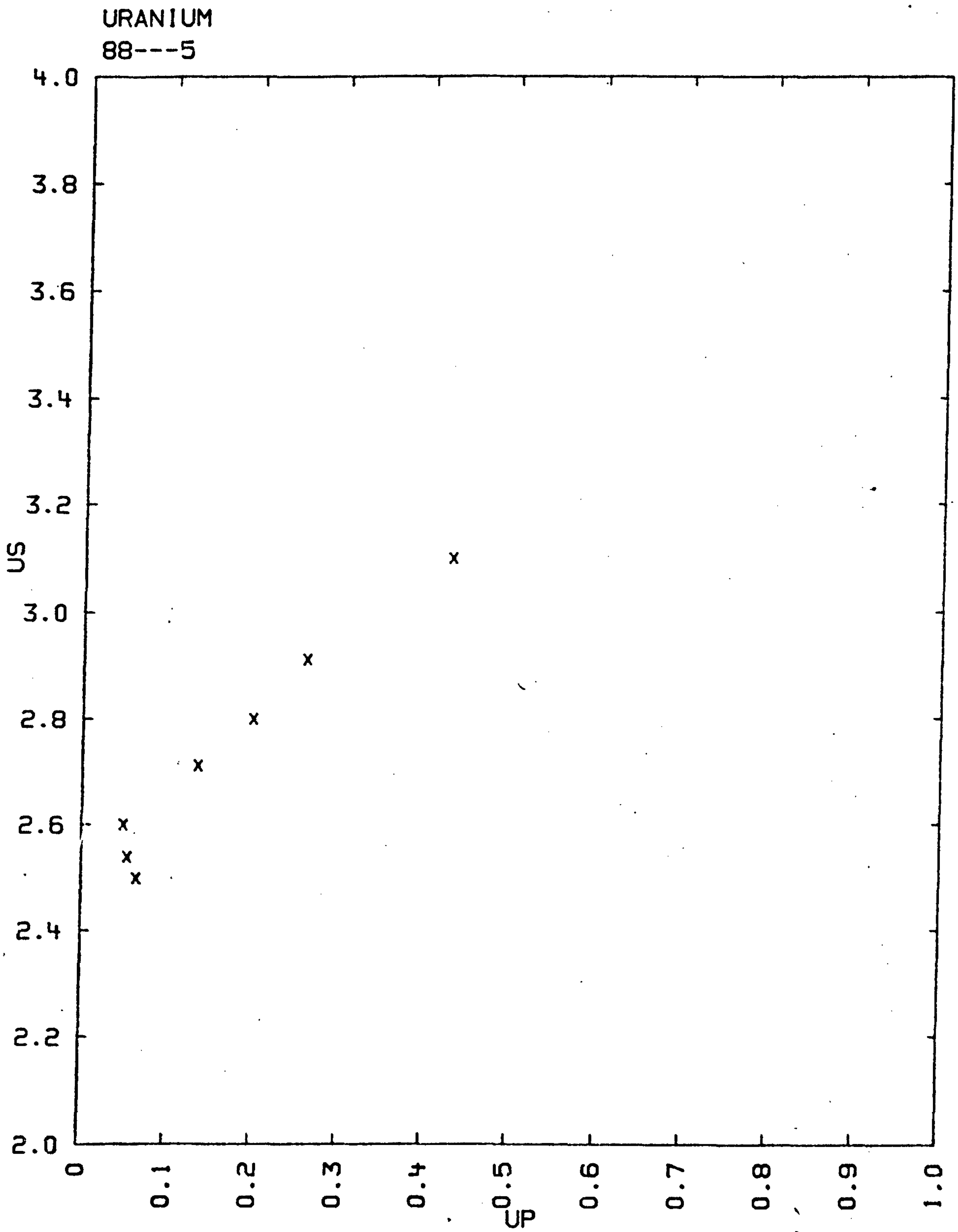
RHO0I	US	UFS	UP	P	V/V0	CL	X	U(PRO)
18.89	2.54	0.110	0.055	26	0.978	3.45		0.317
-	2.80	0.395	0.198	105	0.929	3.54		0.390
-	2.60	0.099	0.050	25	0.816	3.48	2.5	0.105
-	2.91	0.520	0.260	143	0.910	3.52	0.1	0.525
-	3.1	0.855	0.428	251	0.862	3.4	0.1	0.849
-	2.50	0.130	0.065	31	0.974	3.43	1.0	0.152
-	2.71	0.270	0.135	60	0.950	3.32	1.4	0.267

US = 2.48 + 1.53 UP KM/SEC. SIGMA US = 0.05 KM/SEC.

COMMENTS:

1) SOURCE: TAYLOR, J. W.
   LOS ALAMOS SCIENTIFIC LAB. REPORT LADC-5626 (1963)
   LOS ALAMOS NEW MEXICO
2) EXPERIMENTAL TECHNIQUE G.
   DATA REDUCTION TECHNIQUE D. ASSUMING 2UP = UFS, WERE UFS IS THE FINAL FREE SURFACE VELOCITY OF A BROAD WAVE.
3) THE AVERAGE ELASTIC WAVE VELOCITY IS 3.45 KM/SEC. AND ITS FREE-SURFACE VELOCITY IS ABOUT 0.005 KM/SEC., THE AVERAGE PRESSURE IS 1.6 KILOBARS.
4) VOI WAS OBTAINED FROM A.C.A. MONOGRAPH NUMBER 5 (AMERICAN CRYSTALLOGRAPHIC ASSOCIATION, POLYCRYSTAL BOOK SERVICE, BROOKLYN, N.Y., 1963) 2ND ED.
5) THE PRESSURE WAS ACHIEVED BY USING A GUN TO ACCELERATE A PROJECTILE WHICH WAS IMPACTED INTO A PLATE CONTAINING THE SAMPLE.

TABLE I


URANIUM
88---5
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
US
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
UP

88---5
URANIUM

U

VOI = 0.05294 CC/G.

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC., VELOCITIES IN KM/SEC., AND PRESSURE IN KILOBARS. CL IS THE LONGITUDINAL VELOCITY BEHIND THE SHOCK-FRONT. X DESIGNATES THE SHOCK THICKNESS GIVEN IN MICROSECONDS. U(PRO) DESIGNATES THE PROJECTILE VELOCITY AT IMPACT. A WEAK PRECURSOR PRECEDES THE MAIN WAVE. SEE COMMENT 3

TABLE

RHOOI	US	UFS	UP	P	V/V0	CL	X	U(PRO)
18.89	2.54	0.110	0.055	26	0.978	3.45		0.317
-	2.80	0.395	0.198	105	0.929	3.54		0.390
-	2.60	0.099	0.050	25	0.816	3.48	2.5	0.105
-	2.91	0.520	0.260	143	0.910	3.52	0.1	0.525
-	3.1	0.855	0.428	251	0.862	3.4	0.1	0.849
-	2.50	0.130	0.065	31	0.974	3.43	1.0	0.152
-	2.71	0.270	0.135	60	0.950	3.32	1.4	0.267

US = 2.48 + 1.53 UP KM/SEC. SIGMA US = 0.05 KM/SEC.

COMMENTS:

1) SOURCE: TAYLOR, J. W.
LOS ALAMOS SCIENTIFIC LAB. REPORT LADC-5626 (1963)
LOS ALAMOS NEW MEXICO
2) EXPERIMENTAL TECHNIQUE G.
DATA REDUCTION TECHNIQUE D. ASSUMING 2UP = UFS, WERE UFS IS THE FINAL FREE SURFACE VELOCITY OF A BROAD WAVE.
3) THE AVERAGE ELASTIC WAVE VELOCITY IS 3.45 KM/SEC. AND ITS FREE-SURFACE VELOCITY IS ABOUT 0.005 KM/SEC., THE AVERAGE PRESSURE IS 1.6 KILOBARS.
4) VOI WAS OBTAINED FROM A.C.A. MONOGRAPH NUMBER 5 (AMERICAN CRYSTALLOGRAPHIC ASSOCIATION, POLYCRYSTAL BOOK SERVICE, BROOKLYN, N.Y., 1963) 2ND ED.
5) THE PRESSURE WAS ACHIEVED BY USING A GUN TO ACCELERATE A PROJECTILE WHICH WAS IMPACTED INTO A PLATE CONTAINING THE SAMPLE.

88---6
URANIUM

U 99.8 WT. PERCENT

V0 = 0.05277 CC/G   CL = 2.97 KM/SEC   C0 = 2.63 KM/SEC
V0I= 0.05250 - ALPHA U   CS = 1.20 KM/SEC
V0I= 0.05329 - BETHA U

THE TABLE LISTS RHO0 IN G/CC, VELOCITIES IN KM/SEC AND P IN KBARS. CU= COPPER, FS= FANSTEEL AND WF= WEIGHTING FACTOR.

TABLE

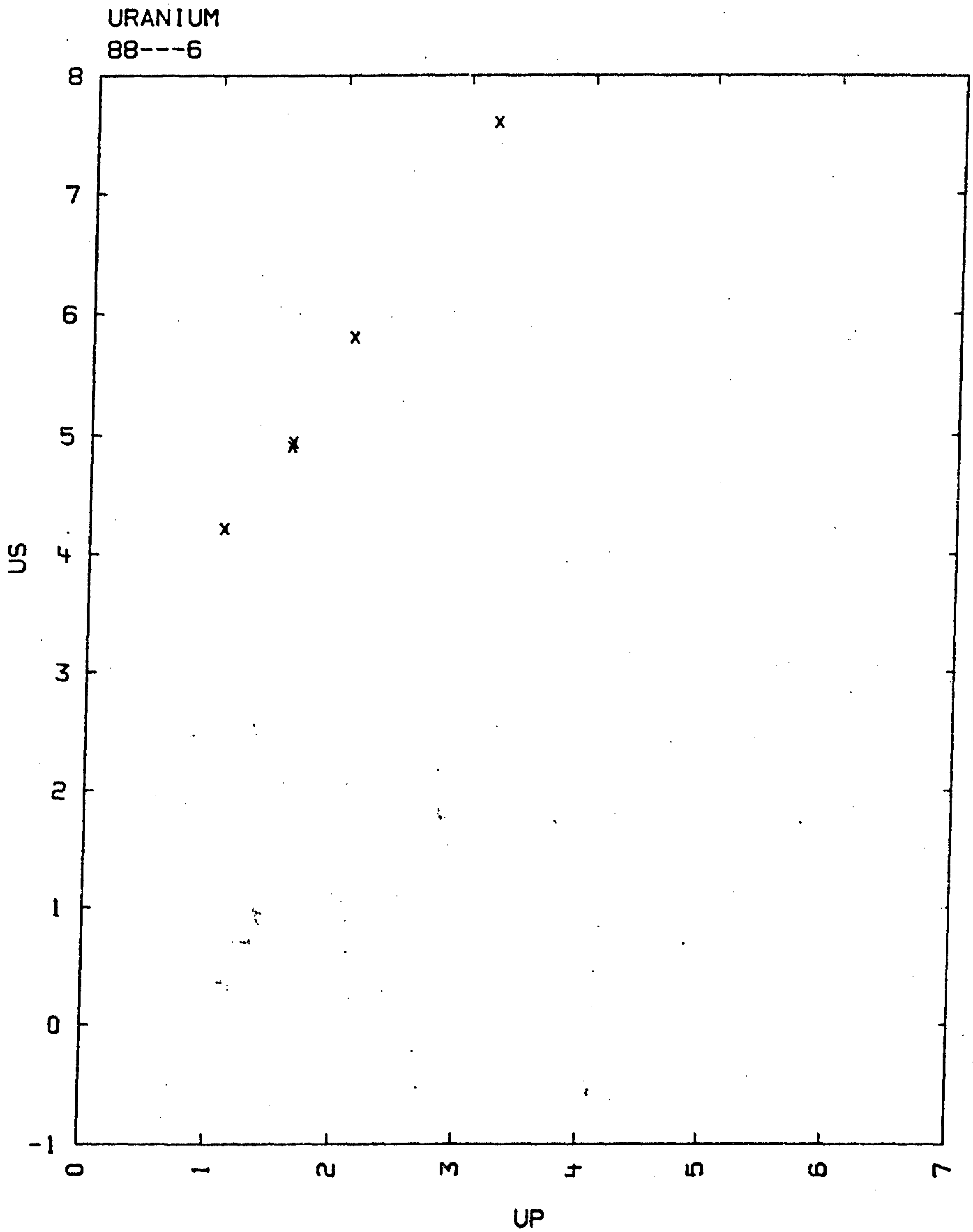
SAMPLE					IMPACTOR		
RHO0	US	UP	P	V/V0	MAT	U	WF
18.95	4.206	1.077	859.	.7439	FS	2.044	3
18.95	4.902	1.602	1488.	.6732	CU	3.885	3
18.95	4.940	1.613	1510.	.6735	CU	3.918	3
18.95	5.806	2.086	2295.	.6407	FS	4.134	3
18.95	7.596	3.214	4627.	.5769	CU	7.967	1

US = 2.443 + 1.582*UP KM/SEC
SIG.US = 0.072 KM/SEC

COMMENTS:

1) SOURCE: ISBELL W.M., SHIPMAN F.H. AND JONES A.H.
HUGONIOT EQUATION OF STATE OF ELEVEN MATERIALS TO FIVE MBARS
MATERIALS SCIENCE LABORATORY REPORT: MSL-68-13
2) EXPERIMENTAL TECHNIQUE: A
DATA REDUCTION METHOD : A
3) NOMINAL UNCERTAINTIES ARE: (SIG.US)/US = .005 AND (SIG.U)/U = .0005
4) POISSON RATIO = 0.402; YIELD STRENGTH = 3.25 KBAR
TENSILE - = 8.55 KBAR
5) IMPURITIES IN PPM.: AL 9, B 0.3, CD 0.3; CR 3, CU 8, FE 10, MG 2, MN 15, MO 2, NI 20, PB 1, SI 40, SM 1

TABLE I



88---7
URANIUM

U 97. WT PERCENT
MO 3. - -

V0 = 0.05420-0.05458 CC/G   CL = 3.31 KM/SEC   C0 = 2.53 KM/SEC
V0I = 0.0543   CS = 1.85 KM/SEC

IN THE TABLES BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBAR AND DENSITY IN G/CC. STANDARD MATERIAL DESCRIBES THE IMPACTOR.

TABLE I

SAMPLE					STANDARD
RHOO	US	UP	P	V/VO	MATERIAL
18.450	3.17	0.41	240.	0.8707	URANIUM
18.450	3.33	0.49	301.	0.8529	URANIUM
18.450	3.67	0.72	488.	0.8038	URANIUM
18.450	3.73	0.75	516.	0.7989	URANIUM
18.450	4.24	1.11	868.	0.7382	URANIUM
18.450	4.54	1.29	1081.	0.7159	URANIUM
18.450	4.53	1.32	1103.	0.7086	URANIUM
18.450	5.19	1.76	1685.	0.6609	URANIUM
18.450	5.31	1.80	1763.	0.6610	URANIUM
18.450	5.36	1.84	1820.	0.6567	URANIUM
18.450	5.83	2.11	2270.	0.6381	URANIUM
18.450	6.06	2.36	2639.	0.6106	URANIUM
18.450	6.27	2.38	2753.	0.6204	URANIUM
18.450	6.51	2.54	3051.	0.6098	URANIUM
18.450	6.76	2.75	3430.	0.5932	URANIUM

US = 2.565 + 1.531*UP KM/SEC HUGONIOT FIT ADOPTED BY THE SOURCE
COMPARISON LEAST SQUARE FITS:
US = A0 + A1*UP KM/SEC
A0 = 2.553 KM/SEC   SIG A0 = 0.029 KM/SEC
AU = 1.532 -   SIG A1 = 0.016 -
SIG US = 0.049 -

TABLE II

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
18.320	2.96	0.24	130.	0.9189	2024 AL	5.98
18.330	3.07	0.31	174.	0.8990	2024 AL	6.18
18.480	3.25	0.41	246.	0.8738	2024 AL	6.45
18.480	3.20	0.42	248.	0.8687	2024 AL	6.45
18.330	3.24	0.43	255.	0.8673	2024 AL	6.48

URANIUM

RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
18.450	3.26	0.45	271.	0.8620	2024 AL	6.55
18.450	3.44	0.58	368.	0.8314	2024 AL	6.87
18.480	3.49	0.59	381.	0.8309	2024 AL	6.91
18.480	3.46	0.59	377.	0.8295	2024 AL	6.91
18.450	3.80	0.82	575.	0.7842	2024 AL	7.48
18.480	3.85	0.83	591.	0.7844	2024 AL	7.54
18.480	4.18	1.11	857.	0.7344	2024 AL	8.21
18.480	4.68	1.40	1211.	0.7009	2024 AL	8.95
18.480	5.10	1.55	1461.	0.6961	2024 AL	9.41
18.480	5.10	1.62	1527.	0.6824	2024 AL	9.54
18.450	5.30	1.69	1653.	0.6811	2024 AL	9.74
18.480	5.31	1.75	1717.	0.6704	2024 AL	9.86
18.480	5.64	1.88	1959.	0.6667	2024 AL	10.23
18.480	5.60	1.91	1977.	0.6589	2024 AL	10.28

US = 2.565 + 1.531*UP KM/SEC
AO = 2.534 KM/SEC SIG AO = 0.026 KM/SEC
A1 = 1.603 - SIG A1 = 0.023 -
SIG US = 0.058 -

TABLE III

----SAMPLE----					----STANDARD----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
18.480	3.05	0.32	180.	0.8951	921-T AL	5.98
18.480	3.50	0.62	401.	0.8229	921-T AL	6.80
18.480	3.87	0.88	629.	0.7726	921-T AL	7.48
18.480	4.29	1.17	928.	0.7273	921-T AL	8.21
18.480	4.66	1.41	1214.	0.6974	921-T AL	8.84
18.480	5.20	1.71	1643.	0.6712	921-T AL	9.65
18.480	5.60	1.95	2018.	0.6518	921-T AL	10.26

US = 2.565 + 1.531*UP KM/SEC
AO = 2.517 KM/SEC SIG AO = 0.038 KM/SEC
A1 = 1.557 - SIG A1 = 0.030 -
SIG US = 0.044 -

TABLE IV

----SAMPLE----					----STANDARD----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
18.480	2.86	0.19	100.	0.9336	CU	4.27
18.480	3.03	0.26	146.	0.9142	CU	4.41
18.480	3.17	0.39	228.	0.8770	CU	4.64
18.480	3.23	0.41	245.	0.8731	CU	4.68
18.330	3.29	0.47	283.	0.8571	CU	4.78
18.480	3.35	0.53	328.	0.8418	CU	4.87

URANIUM

RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
18.450	3.42	0.55	347.	0.8392	CU	4.93
18.490	3.79	0.80	561.	0.7889	CU	5.37
18.480	3.80	0.82	576.	0.7842	CU	5.40
18.450	3.77	0.82	570.	0.7825	CU	5.40
18.450	3.78	0.84	586.	0.7778	CU	5.43
18.480	3.82	0.84	593.	0.7801	CU	5.44
18.480	3.83	0.86	609.	0.7755	CU	5.47
18.450	3.91	0.88	635.	0.7749	CU	5.51
18.480	4.25	1.14	895.	0.7318	CU	5.97
18.480	4.55	1.30	1093.	0.7143	CU	6.27
18.450	4.57	1.35	1138.	0.7046	CU	6.35
18.480	4.68	1.42	1228.	0.6966	CU	6.48
18.480	5.10	1.67	1574.	0.6725	CU	6.93
18.480	5.09	1.67	1571.	0.6719	CU	6.94
18.450	5.31	1.80	1763.	0.6610	CU	7.18
18.480	5.48	1.91	1934.	0.6515	CU	7.37
18.450	5.47	1.91	1928.	0.6508	CU	7.38
18.480	5.73	2.00	2118.	0.6510	CU	7.57
18.480	5.75	2.04	2168.	0.6452	CU	7.62
18.480	5.72	2.04	2156.	0.6434	CU	7.61
18.480	5.78	2.07	2211.	0.6419	CU	7.67
18.480	5.95	2.21	2430.	0.6286	CU	7.91
18.480	5.88	2.24	2434.	0.6190	CU	7.94
18.480	6.10	2.29	2581.	0.6246	CU	8.07
18.320	6.12	2.31	2590.	0.6225	CU	8.08

US = 2.565 + 1.531•UP KM/SEC
A0 = 2.552 KM/SEC   SIG A0 = 0.018 KM/SEC
A1 = 1.536 -   SIG A1 = 0.012 -
SIG US = 0.046 -

TABLE V

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
18.330	3.49	0.57	365.	0.8367	FE	4.93
18.330	3.85	0.82	579.	0.7870	FE	5.49
18.330	4.56	1.31	1095.	0.7127	FE	6.53
18.330	5.04	1.61	1487.	0.6806	FE	7.15
18.320	5.77	2.05	2167.	0.6447	FE	8.05
18.320	6.13	2.31	2594.	0.6232	FE	8.54

US = 2.565 + 1.531•UP KM/SEC
A0 = 2.592 KM/SEC   SIG US = 0.032 KM/SEC
A1 = 1.532 -   SIG A1 = 0.020 -
SIG US = 0.031 -

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES, HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE A (TABLE I), B (THE REST)
3) TABLE I LISTS THE STANDARD HUGONIOT OBTAINED WITH SYMMETRIC IMPACT. TABLES II THROUGH V CHECK THE INTERNAL CONSISTENCY OF THE OTHER STANDARDS OBTAINED WITH SYMMETRIC IMPACT.
4) ALSO GIVEN ARE V.DP/DE = 2.03, (DV/DT)/V = 3.84E-5 PER DEG. AND CP = 0.121 JOULES PER G. DEG.
5) V01 WAS CALCULATED FROM THE ALPHA PRIME - ALPHA DOUBLE PRIME STRUCTURE MIX OBTAINED BY WATER QUENCHING THE GAMMA PHASE TO YIELD LATTIC CONSTANTS A0 = 2.869 B0 = 5.782 C = 4.958 ANGSTROMS AND GAMMA = 91.12 DEGREES. FOR THE ABOVE AVERAGE MOLECULAR WEIGHT OF 227.90 G/MOL. (3 WT PERCENT MO). K. TANGRIC AND G.I. WILLIAMS, J. NUCL. MATS. NO. 4, P. 226, (1961).
6) THE 921-T AL PLATE STOCK USED TO OBTAIN THE CROSS CHECK DATA IN TABLE III IS SLIGHTLY POROUS

TABLE I

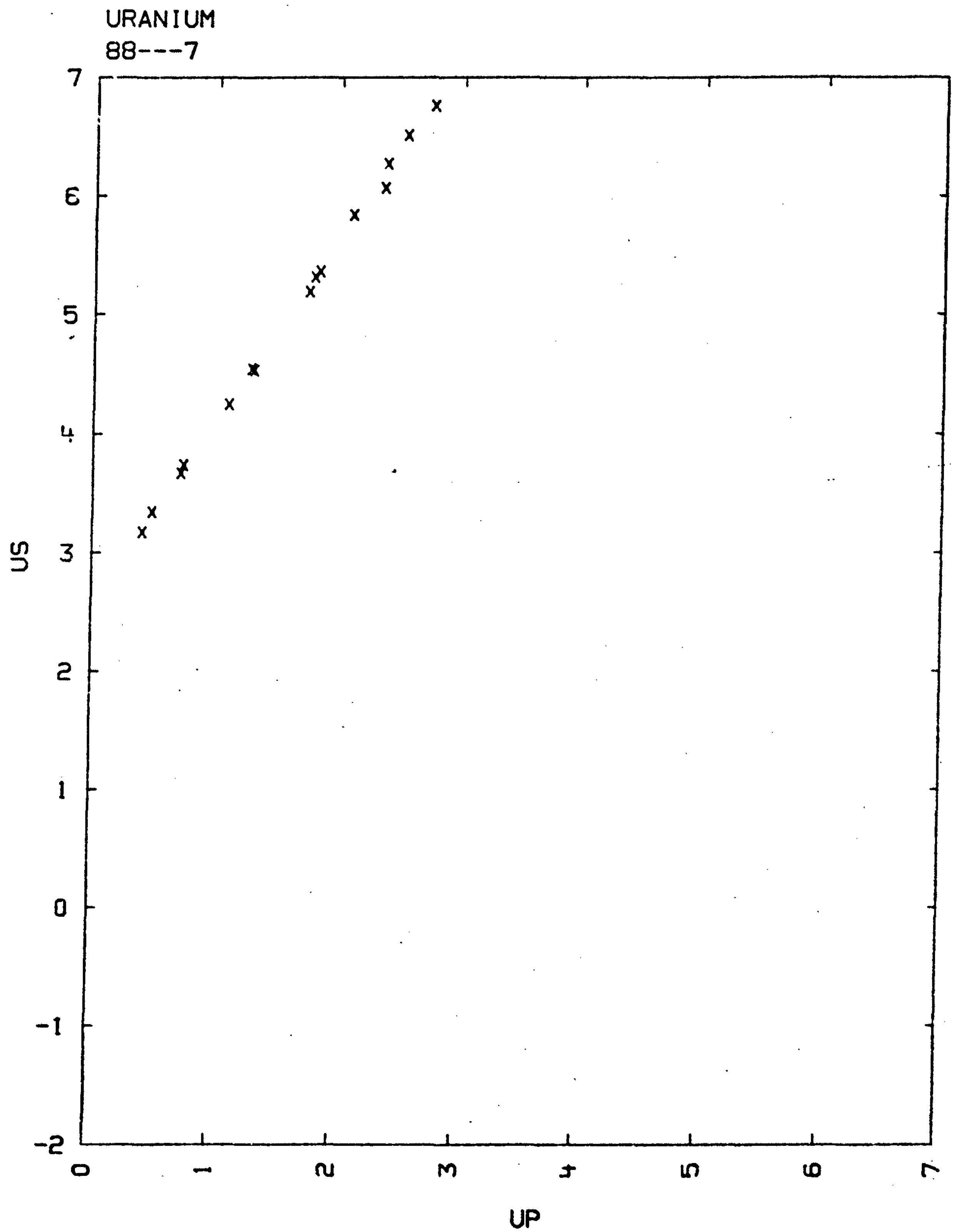


TABLE II

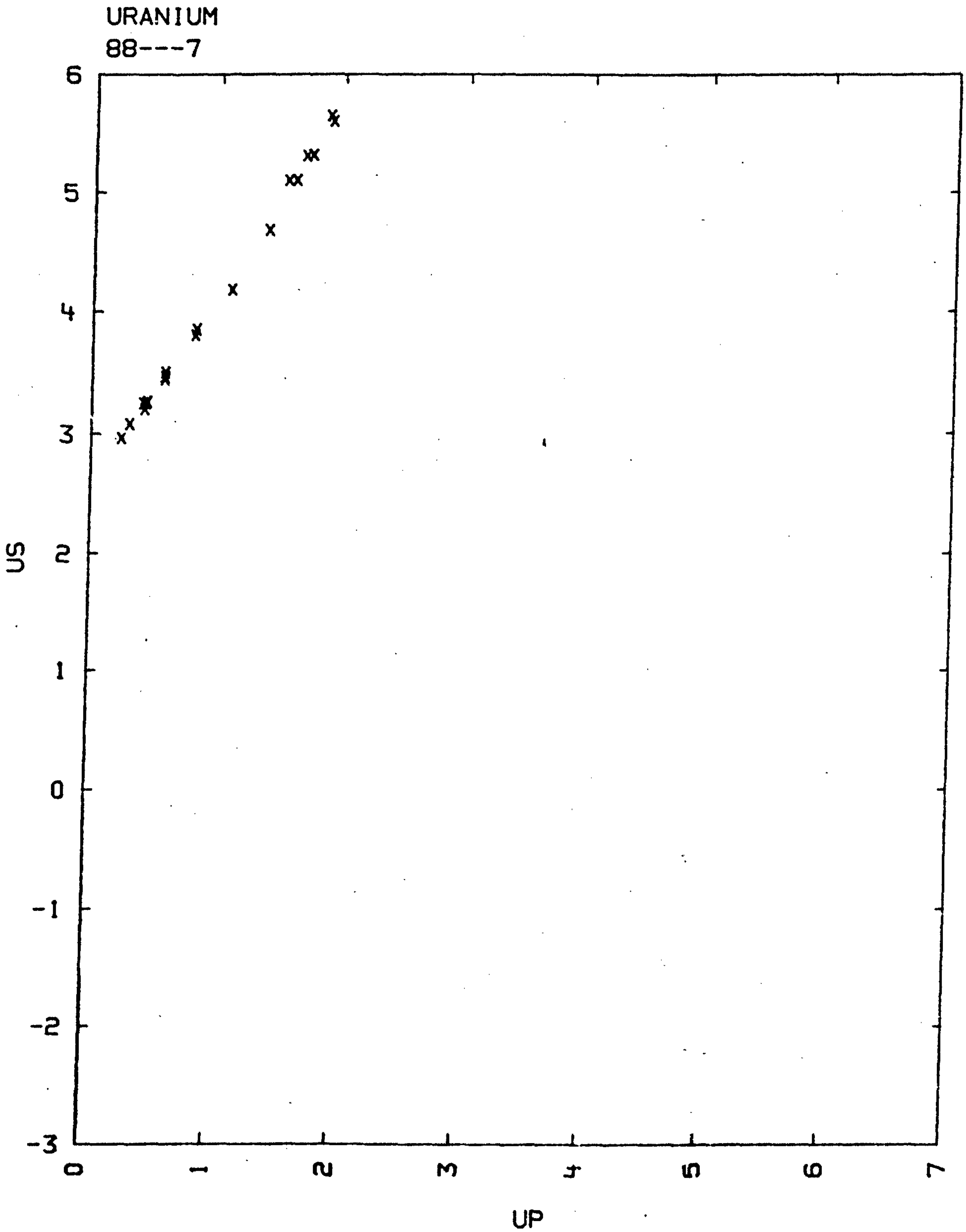


TABLE III

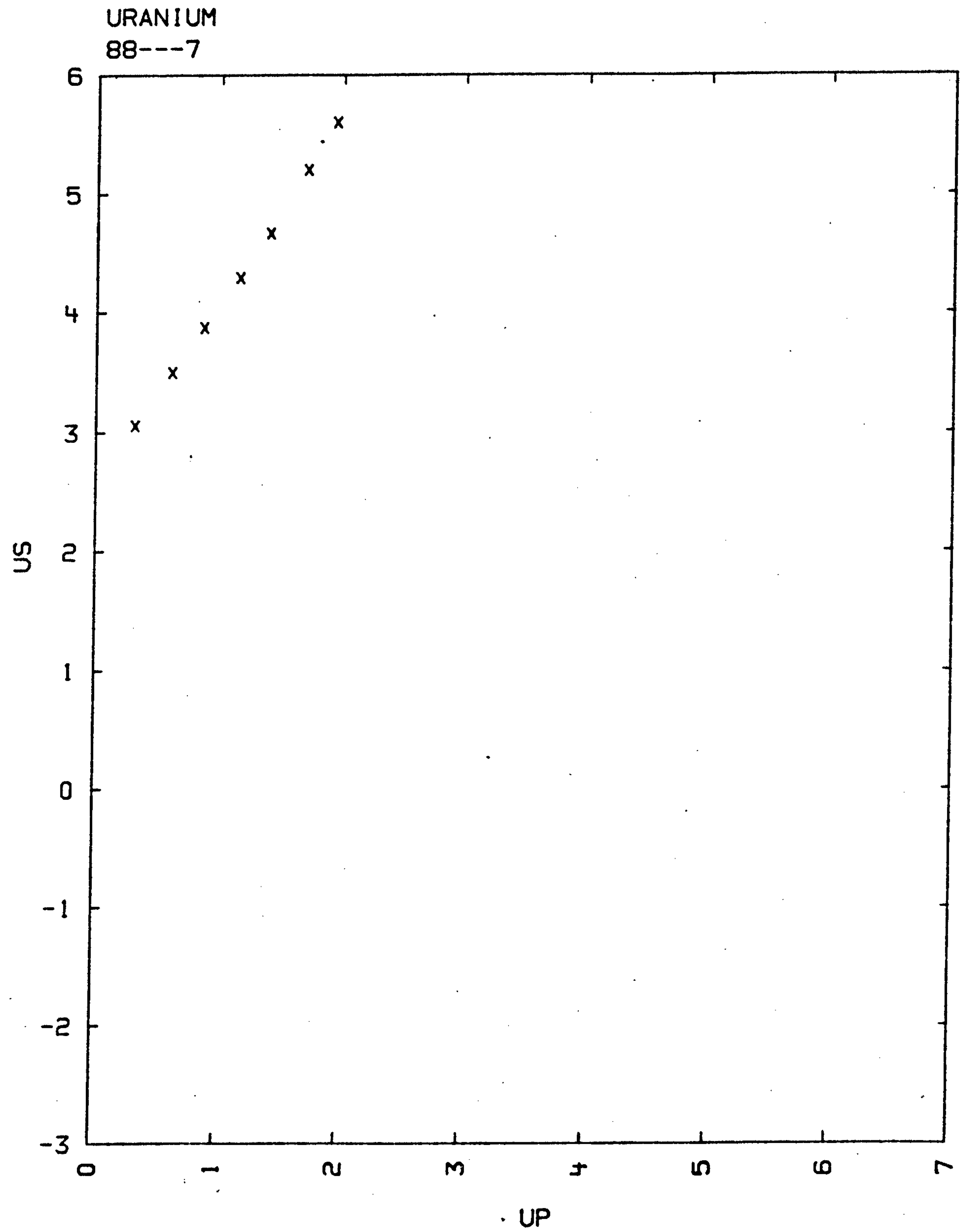


TABLE IV

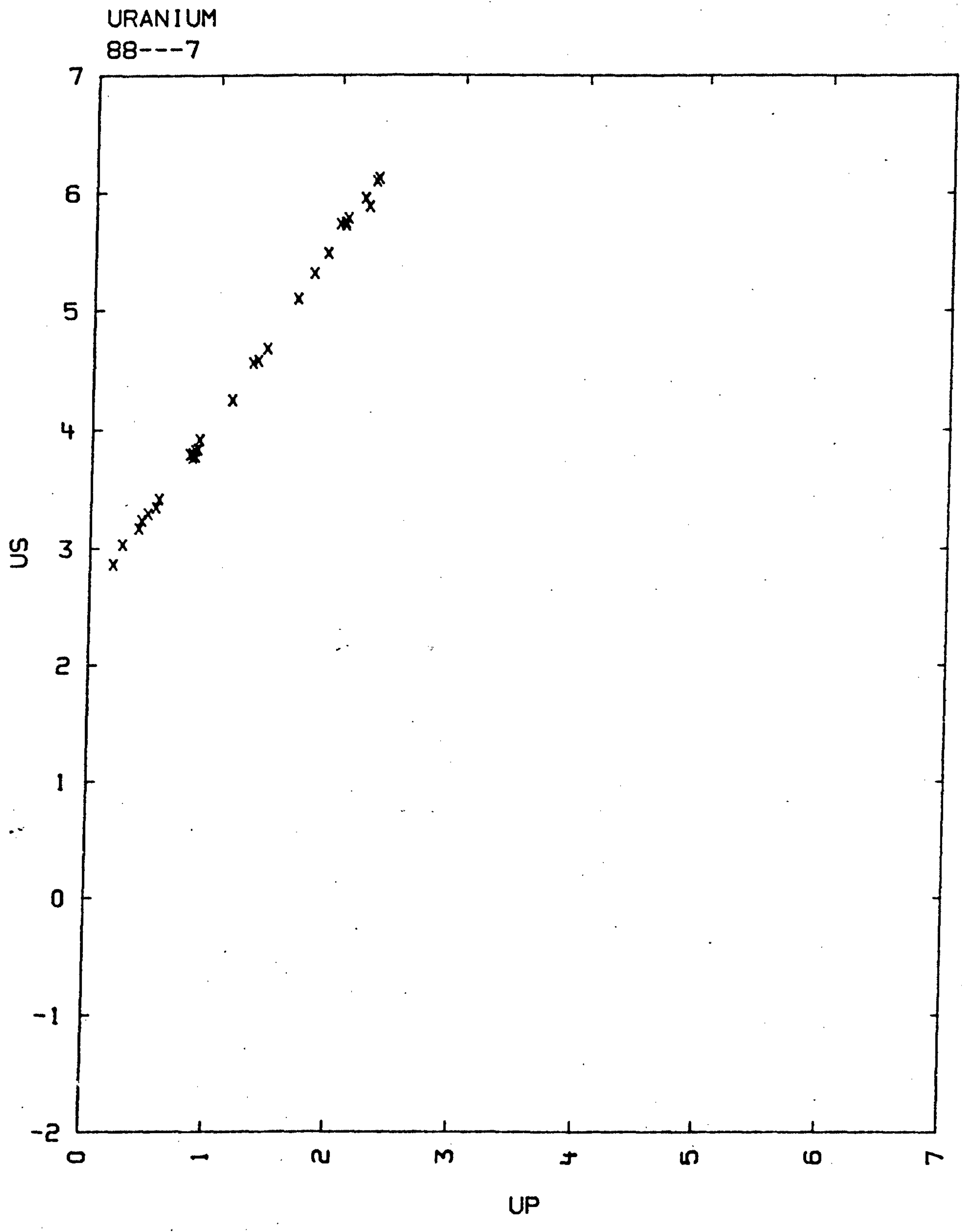
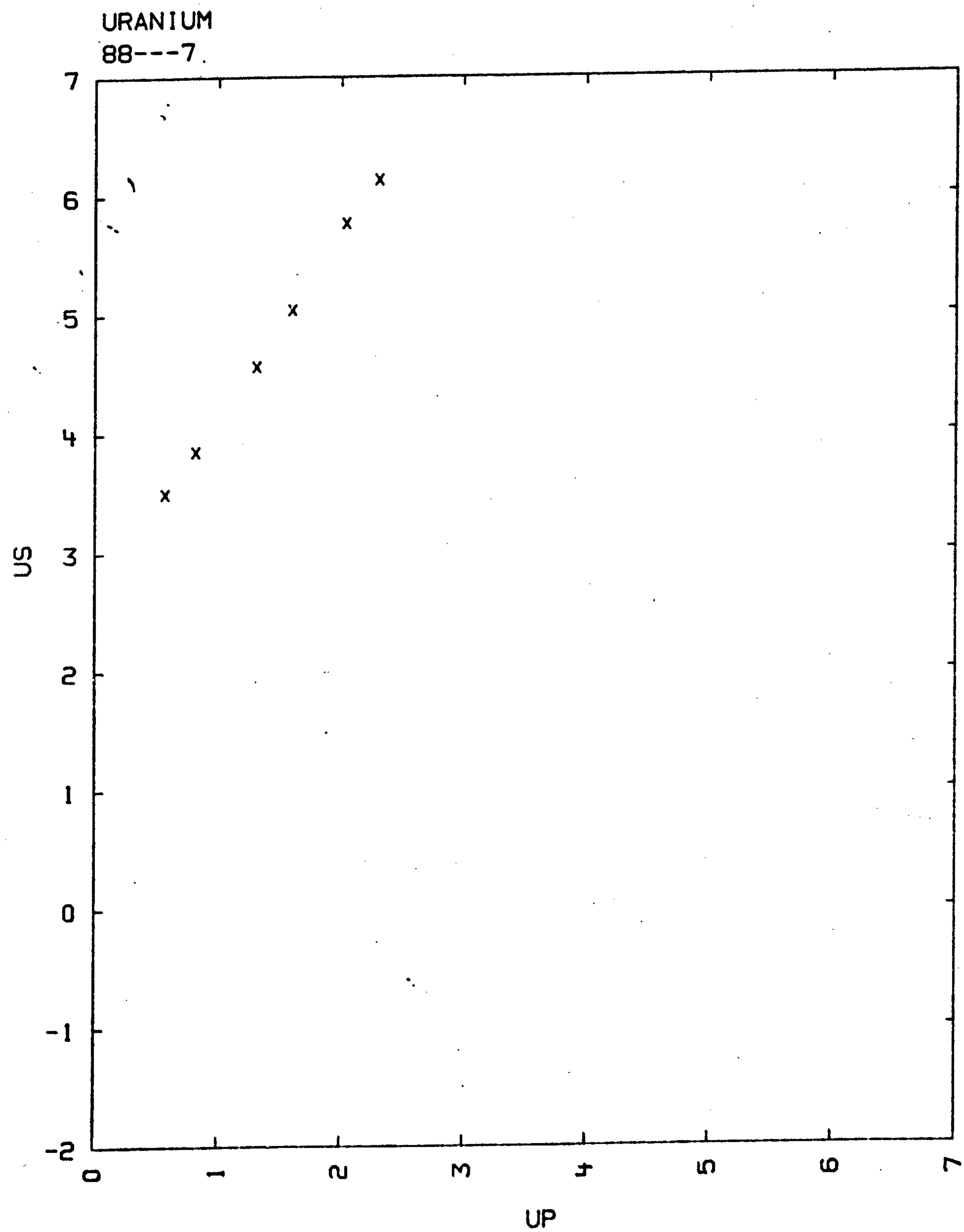


TABLE V



90---1
THORIUM

TH 99.8 PER CENT OR GREATER

VO = 0.0856 CC/G.
VOI = 0.0833 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN MM/MICROSEC.
PRESSURE IN KILOBARS, AND DENSITY IN G/CC.

TABLE

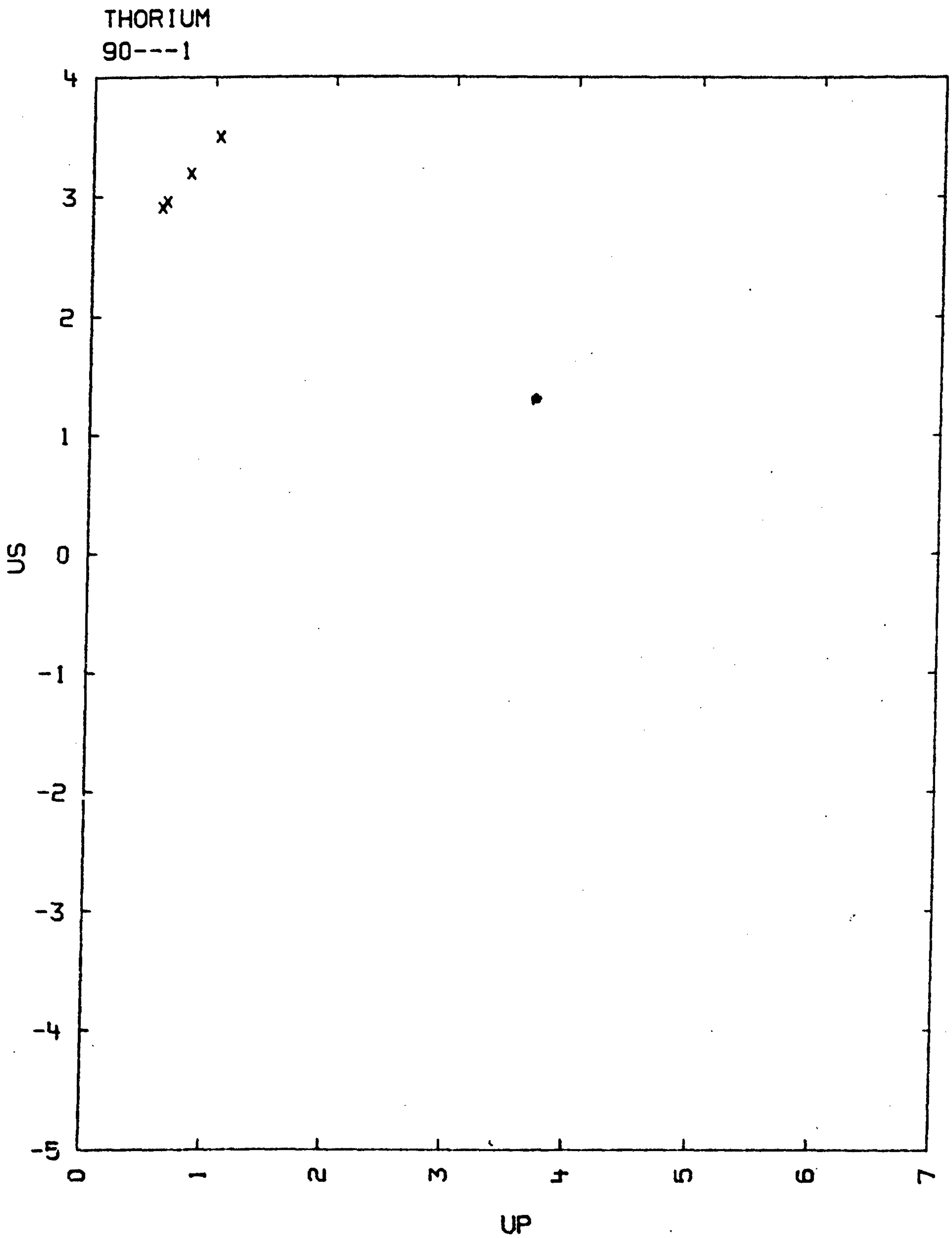
RHOO	US	UFS	UP	P	V/VO
11.68	3.497	2.112	1.043	426.0	0.7017
-	3.192	1.604	0.812	302.7	0.7456
-	2.954	1.246	0.620	213.9	0.7901
-	2.900	1.198	0.571	193.4	0.8031

US = 2.170 + 1.268 UP KM/SEC   SIGMA US = 0.2 PERCENT

COMMENTS:

1) SOURCE: WALSH, J. M., RICE, M. H., MCQUEEN, R. G. AND YARGER, F. L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 1 PER CENT IN COMPRESSION AT A GIVEN PRESSURE.
4) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS

TABLE I



90---2
THORIUM

TH

VO = 0.0856 CC/G. CO = 2.05 KM/SEC.
VOI = 0.0847 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURES IN KILOBARS AND DENSITY IN G/CC.

TABLE

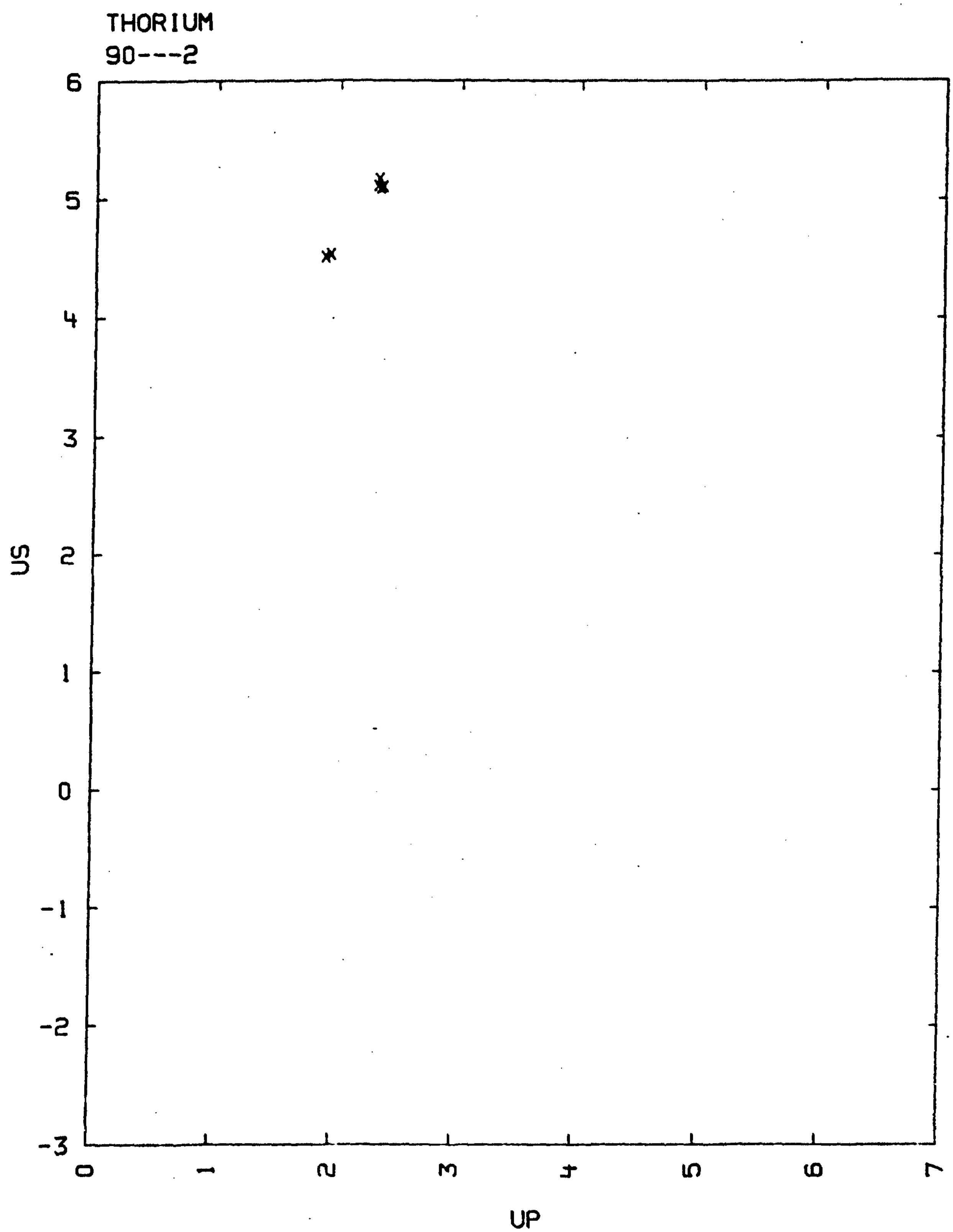
RHOO	US	UP	P	V/VO	PRESSURE BRASS STANDARD
11.68	4.51	1.90	1003	0.578	1028
-	4.53	1.94	1026	0.572	1022
-	5.16	2.32	1400	0.550	1403
-	5.11	2.31	1378	0.548	1385
-	5.09	2.33	1384	0.543	1396
-	5.10	2.36	1405	0.538	1414

US = 2.132 + 1.278 UP KM/SEC. SIGMA US = 0.74 PERCENT

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
J. APPL. PHYS., VOL. 31, P. 1253 (1960)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS BRASS
3) FOR THE BRASS STANDARD DATA SEE MATERIAL 36-33
4) VOI WAS TAKEN FROM THE A. I. P. HANDBOOK (MCGRAW HILL BOOK CO.)
2ND ED.

TABLE I



92---1
BERYLLIUM

BE 100 PERCENT

VO = .5402 CC/G
VOI = .540 CC/G

CO = 8.137 KM/SEC
CB = 7.934 KM/SEC

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN MM/MICROSEC AND PRESSURE IN KILOBARS.

TABLE

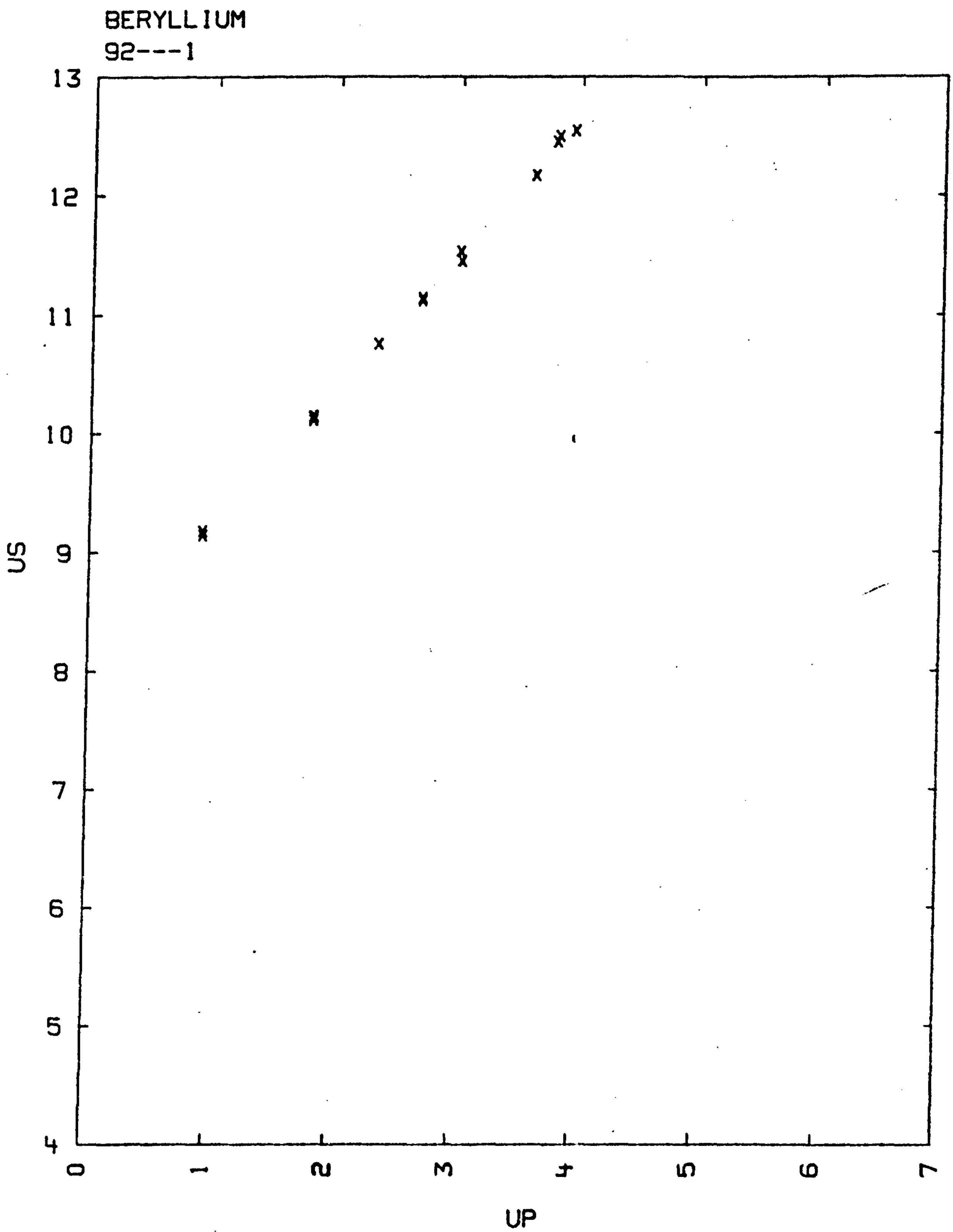
---------BERYLLIUM---------------					ALUMINUM STANDARD	
RHOO	US	UP	P	V/VO	RHOO	US
1.851	9.174	.931	158.1	.8985	2.784	6.566
	9.137	.932	157.6	.8980	2.784	6.566
	10.146	1.818	341.4	.8208	2.784	7.670
	10.128	1.819	341.0	.8204	2.784	7.670
	10.111	1.821	340.8	.8199	2.784	7.670
	10.758	2.336	465.2	.7829	2.788	8.306
	11.143	2.689	554.6	.7587	2.788	8.735
	11.120	2.691	553.9	.7580	2.788	8.735
	11.530	3.001	640.5	.7397	2.788	9.117
	11.451	3.009	637.8	.7372	2.788	9.117
	12.165	3.620	815.1	.7024	2.784	9.858
	12.160	3.621	815.0	.7022	2.784	9.858
	12.445	3.799	875.1	.6947	2.783	10.08
	12.491	3.816	882.3	.6945	2.780	10.11
	12.535	3.951	916.7	.6848	2.788	10.25

US = 8.056 + 1.145 UP, SIG.US = 0.038 KM/SEC.

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
REPORT NO. GMX-6-566, PP. 51-62 (1964)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 2024 ALUMINUM
3) THE HUGONIOT ELASTIC LIMIT IS HIGHLY DEPENDENT ON CRYSTAL ORIENTATION
POPE,L.E. AND JOHNSON J.N. J. APPL. PHYS. V.46 P.720 (1975)

TABLE I



92---2
BERYLLIUM

BE 99.8 PER CENT OR GREATER

VO = 0.5420 CC/G. CL = 12.89 KM/SEC. CO = 7.81 KM/SEC.
VOI = 0.5412 CC/G. CS = 8.880 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURE IN KILOBARS, AND DENSITY IN G/CC.

TABLE

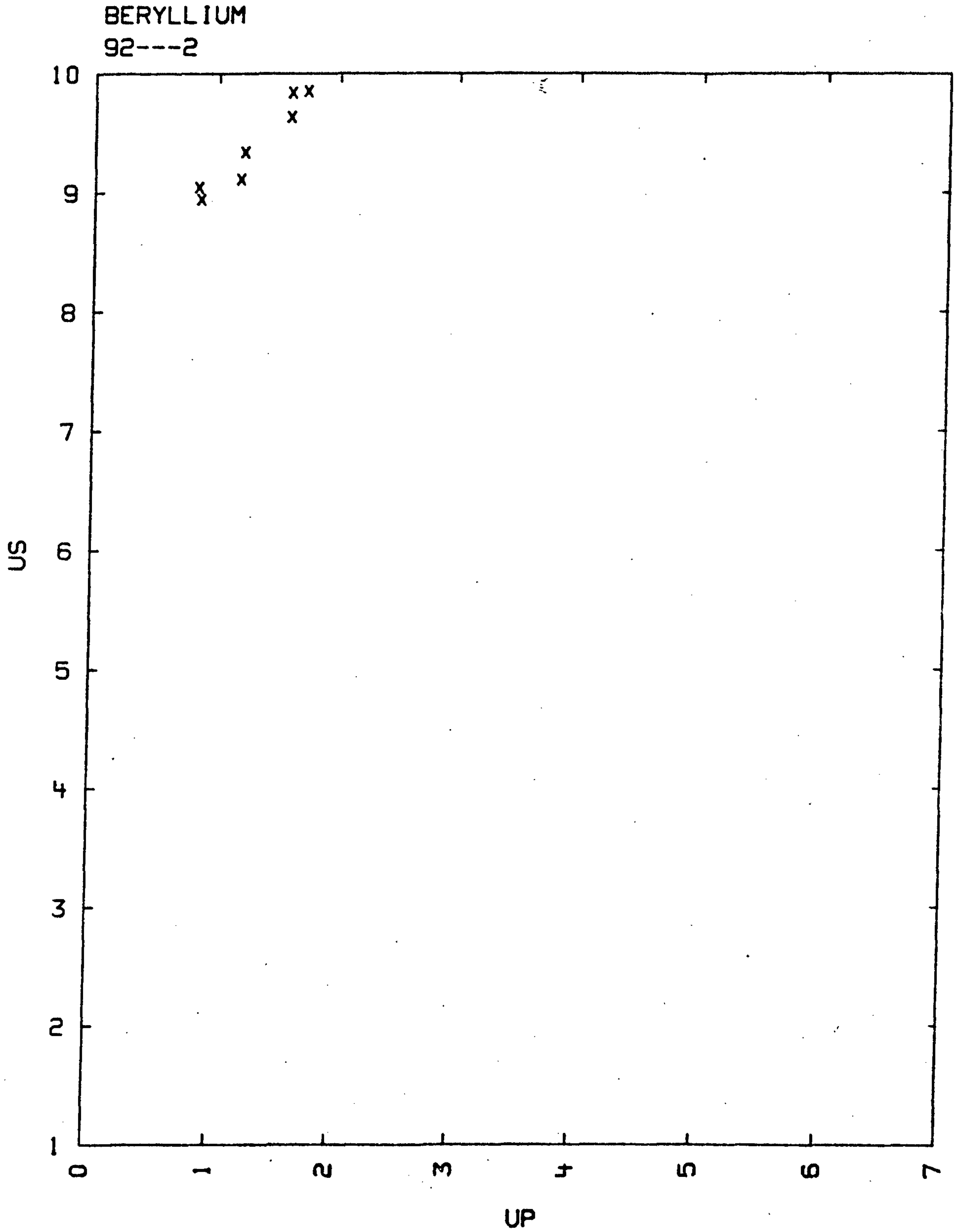
RHOO	US	UFS	UP	P	V/VO
1.845	9.044	1.697	0.847	141.3	0.9063
-	8.934	1.739	0.865	142.6	0.9032
-	9.112	2.358	1.189	199.9	0.8695
-	9.332	2.364	1.221	210.2	0.8692
-	9.851	3.422	1.730	314.4	0.8244
-	9.832	3.235	1.609	291.9	0.8364
-	9.633	3.189	1.592	282.9	0.8347

US = 8.069 + 1.023 UP KM/SEC   SIGMA US = 1.2 PERCENT

COMMENTS:

1) SOURCE: WALSH, J. M., RICE, M. H., MCQUEEN, R. G. AND YARGER, F. L.
PHYS. REV., VOL. 108, P. 169 FF. (1957)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 24ST ALUMINUM
3) IMPURITIES WERE MEASURED BY SPECTROCHEMICAL ANALYSIS.
4) CL AND CS WERE OBTAINED FROM D. GRAY, AMERICAN INSTITUTE OF PHYSICS HANDBOOK, 1957, 2ND. ED., P. 33-82
5) THE PROBABLE ERROR PER DATA POINT IS 0.7 PER CENT IN SHOCK VELOCITY FOR A GIVEN FREE-SURFACE VELOCITY AND APPROXIMATELY 1 PERCENT IN COMPRESSION AT A GIVEN PRESSURE.
6) VOI WAS TAKEN FROM THE A. I. P. HANDBOOK (MCGRAW HILL BOOK CO.) 2ND ED.

TABLE I



92---3
BERYLLIUM POROUS

BE

VO = 0.772 CC/G
VOI = 0.5420 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN KM/SEC AND PRESSURE IN KILOBARS.

TABLE

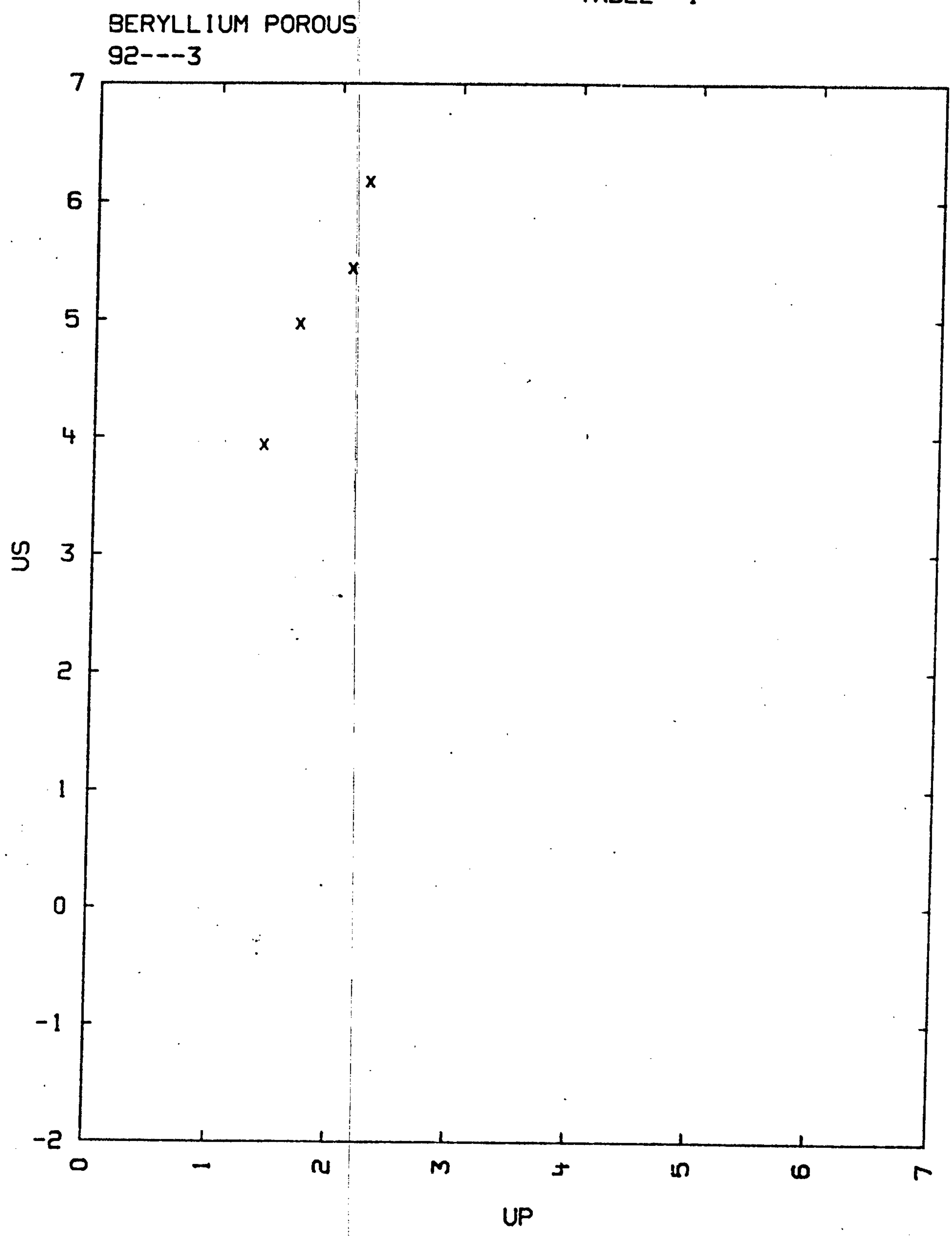
SAMPLE						AL BASE PLATE
RHOO	US	UFS	UP	P	V/VO	PRESSURE
1.274	3.93	1.57	1.40	70	0.644	165
1.31	4.96	2.43	1.68	109	0.661	224
1.295	5.43	3.08	2.11	148	0.612	296
1.31	6.17	3.57	2.24	182	0.637	335

US = 0.79 + 2.33 UP KM/SEC
SIGMA US = 0.302 KM/SEC

COMMENTS:

1) SOURCE: COMPILER
   L.R.L. EQUATION OF STATE FILE
   LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIFORNIA.
2) EXPERIMENTAL TECHNIQUE B. STANDARD MATERIAL 2024 AL ALLOY.
   DATA REDUCTION TECHNIQUE B.
3) THE VALUE OF VOI WAS OBTAINED FROM A. TAYLOR AND BRENDA J. KAGLE, CRYSTALLOGRAPHIC DATA ON METAL AND ALLOY STRUCTURES (DOVER PUBLICATIONS, INC., NEW YORK, N. Y., 1963).

TABLE I



92---4
BERYLLIUM

TYPE	S-200	I-400		
BE	98.18	95.77	WT.	PERCENT
BE-O	2.00	3.96	-	-
C	0.126	0.18	-	-
FE	0.163	0.16	-	-
AL	0.054	0.04	-	-
MG	0.035	0.02	-	-
SI	0.080	0.04	-	-
MN	----	0.01	-	-
REST	0.04 MAX	0.10	-	-

S-200 :
VO = 0.5385 CC/G CL= 12.916 KM/SEC CO= 7.87 KM/SEC
CS= 8.86 KM/SEC
I-400 :
VO = 0.5316 CC/G CL= 12.83 KM/SEC CO= 7.83 KM/SEC
CS= 8.80 KM/SEC
VOI= 0.5421 CC/G

THE TABLE LISTS RHOO IN G/CC, VELOCITIES IN KM/SEC AND P IN KBARS.
FS= FANSTEEL, CU= COPPER AND WF= WEIGHTING FACTOR.

TABLE

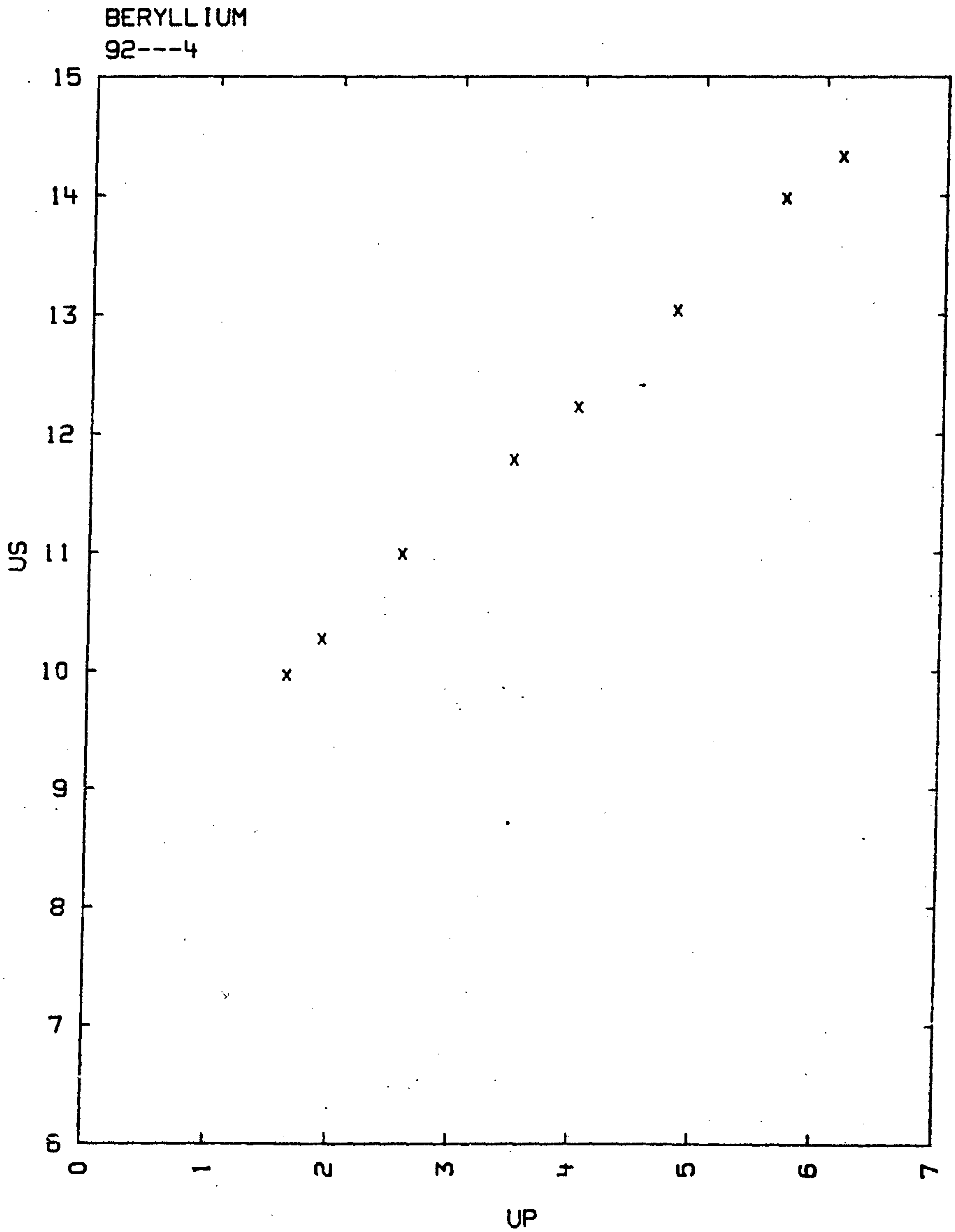
- - - - - - - - SAMPLE					- - - - - - - -	- - IMPACTOR - -		
MAT	RHOO	US	UP	P	V/VO	MAT	U	WF
S-200	1.851	9.965	1.631	302.	.8363	FS	2.205	3
-	1.851	10.266	1.903	363.	.8147	CU	2.695	3
-	1.851	11.779	3.459	757.	.7063	FS	4.330	3
-	1.851	12.218	3.990	905.	.6734	CU	5.596	1
-	1.851	13.034	4.792	1160.	.6324	FS	7.734	3
-	1.851	13.970	5.678	1473.	.5936	CU	7.945	3
-	1.851	14.324	6.139	1633.	.5714	FS	7.734	1
I-400	1.881	10.981	2.549	526.	.7679	FS	3.191	0

US = 8.390 + 0.975*UP KM/SEC
SIG.US = 0.017 KM/SEC

COMMENTS:

1) SOURCE: ISBELL W.M., SHIPMAN F.H. AND JONES A.H.
HUGONIOT EQUATION OF STATE OF ELEVEN MATERIALS TO FIVE MBARS.
MATERIALS SCIENCE LABORATORY REPORT: MSL-68-13
2) EXPERIMENTAL TECHNIQUE: A
DATA REDUCTION METHOD : A
3) NOMINAL UNCERTAINTIES ARE: (SIG.US)/US = .005 AND (SIG.U)/U = .005
4) ALSO LISTED: POISSONS RATIO: 0.055; ULTIMATE TENSILE STRENGTH:
3.98 KBAR (S-200); 4.60 KBAR (I-400); YIELD STRENGTH: 2.58 KBAR
(S-200); 3.86 KBAR (I-400)
5) VOI OBTAINED FROM WYCKOFF CRYSTAL STRUCTURES
(JOHN WILEY AND SONS, N.Y. 1963) VOL.I

TABLE I



92---5
BERYLLIUM

BE COMMENT 5
0 - -

VO = 0.5402 CC/G CL = 13.18 KM/SEC CO = 8.14 KM/SEC
VOI = 0.5421 CC/G CS = 8.98 KM/SEC CB = 7.93 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
1.850	8.99	0.34	57.	0.9622	CU	4.31
1.850	8.58	0.48	76.	0.9441	2024 AL	5.96
1.850	8.67	0.49	79.	0.9435	2024 AL	5.98
1.850	8.60	0.50	80.	0.9419	2024 AL	5.98
1.850	8.59	0.50	79.	0.9418	2024 AL	5.98
1.850	8.78	0.68	110.	0.9226	2024 AL	6.22
1.851	9.04	0.88	147.	0.9027	2024 AL	6.47
1.851	9.01	0.88	147.	0.9023	2024 AL	6.47
1.850	9.05	0.93	156.	0.8972	2024 AL	6.53
1.850	9.02	0.93	155.	0.8969	2024 AL	6.53
1.850	9.05	0.94	157.	0.8961	2024 AL	6.54
1.850	9.05	1.02	171.	0.8873	921-T AL	6.43
1.850	9.03	1.02	170.	0.8870	921-T AL	6.43
1.850	9.42	1.25	218.	0.8673	2024 AL	6.92
1.850	9.06	1.25	210.	0.8620	2024 AL	6.91
1.850	9.02	1.26	210.	0.8603	2024 AL	6.91
1.850	9.39	1.34	233.	0.8573	921-T AL	6.86
1.850	9.36	1.34	232.	0.8568	921-T AL	6.86
1.850	9.96	1.75	322.	0.8243	2024 AL	7.55
1.850	9.94	1.75	322.	0.8239	2024 AL	7.55
1.851	10.00	1.76	326.	0.8240	2024 AL	7.56
1.851	9.98	1.76	325.	0.8236	2024 AL	7.56
1.851	9.97	1.76	325.	0.8235	2024 AL	7.56
1.850	10.01	1.77	328.	0.8232	921-T AL	7.43
1.850	9.97	1.78	328.	0.8215	921-T AL	7.43
1.850	9.97	1.80	332.	0.8195	2024 AL	7.60
1.850	10.01	1.84	341.	0.8162	921-T AL	7.52
1.850	9.99	1.85	342.	0.8148	921-T AL	7.52
1.850	10.58	2.21	433.	0.7911	2024 AL	8.12
1.851	10.60	2.27	445.	0.7858	2024 AL	8.19
1.851	10.98	2.62	532.	0.7614	2024 AL	8.61
1.851	10.96	2.63	534.	0.7600	2024 AL	8.61
1.853	11.07	2.78	570.	0.7489	921-T AL	8.72
1.850	11.41	2.92	616.	0.7441	2024 AL	8.98
1.851	11.36	2.93	616.	0.7421	2024 AL	8.99
1.851	11.29	2.94	614.	0.7396	2024 AL	8.99
1.855	11.42	3.16	669.	0.7233	2024 AL	9.24

BERYLLIUM

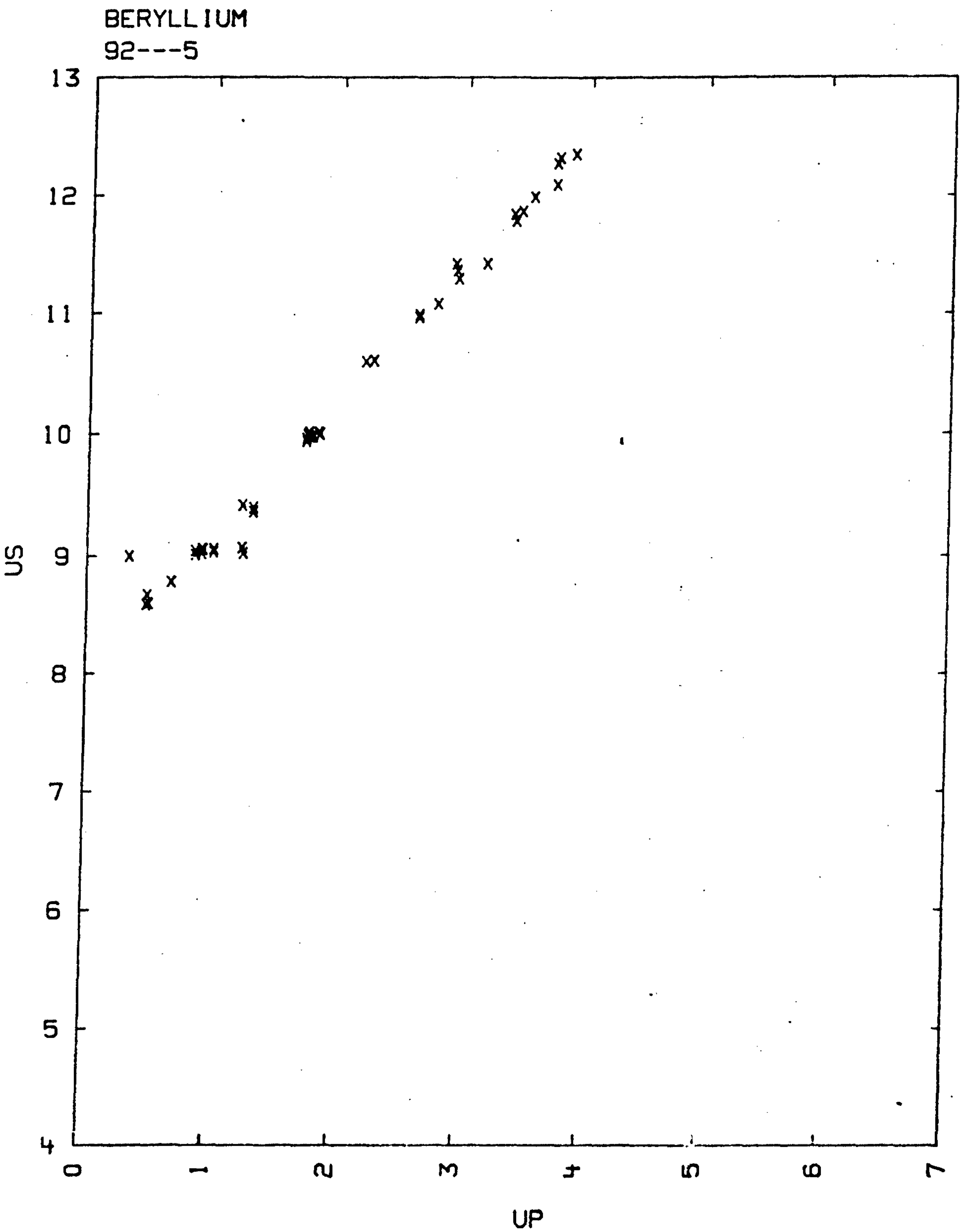
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
1.851	11.84	3.38	741.	0.7145	921-T AL	9.47
1.851	11.78	3.39	739.	0.7122	921-T AL	9.47
1.835	11.86	3.44	749.	0.7099	921-T AL	9.54
1.851	11.98	3.54	785.	0.7045	2024 AL	9.72
1.851	11.99	3.54	786.	0.7048	2024 AL	9.72
1.851	12.08	3.72	832.	0.6921	921-T AL	9.88
1.851	12.27	3.72	845.	0.6968	2024 AL	9.94
1.851	12.31	3.74	852.	0.6962	2024 AL	9.96
1.851	12.35	3.87	885.	0.6866	2024 AL	10.11

US = 7.998 + 1.124*UP KM/SEC
SIGMA US = 0.137 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M., AND CARTER, W.J. THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES, HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII
2) EXPERIMENTAL TECHNIQUE: B
   DATA REDUCTION TECHNIQUE: B
3) V0I FROM WYCKOFF, CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, N.Y. (1963) V1
4) V(DP/DE) = 1.16
5) OXYGEN CONTENT PROBABLY SMALL. SAMPLES WERE SINTERED.
6) HUGONIOT ELASTIC LIMIT 40. KBAR (C-AXIS), 4. KBAR, BASAL PLANE

TABLE I



93---1
MAGNESIUM

THE DOW METAL PRODUCTS COMPANY ALLOY AZ31B

MG 96.0 PERCENT BY WEIGHT
AL 3.0 PERCENT -
ZN 1.0 PERCENT -

VO = 0.563 CC/G CL = 5.60 KM/SEC CO = 4.46 KM/SEC
VOI = 0.565 CC/G CS = 2.93 KM/SEC

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN KM/SEC, AND PRESSURE IN KILOBARS.

TABLE

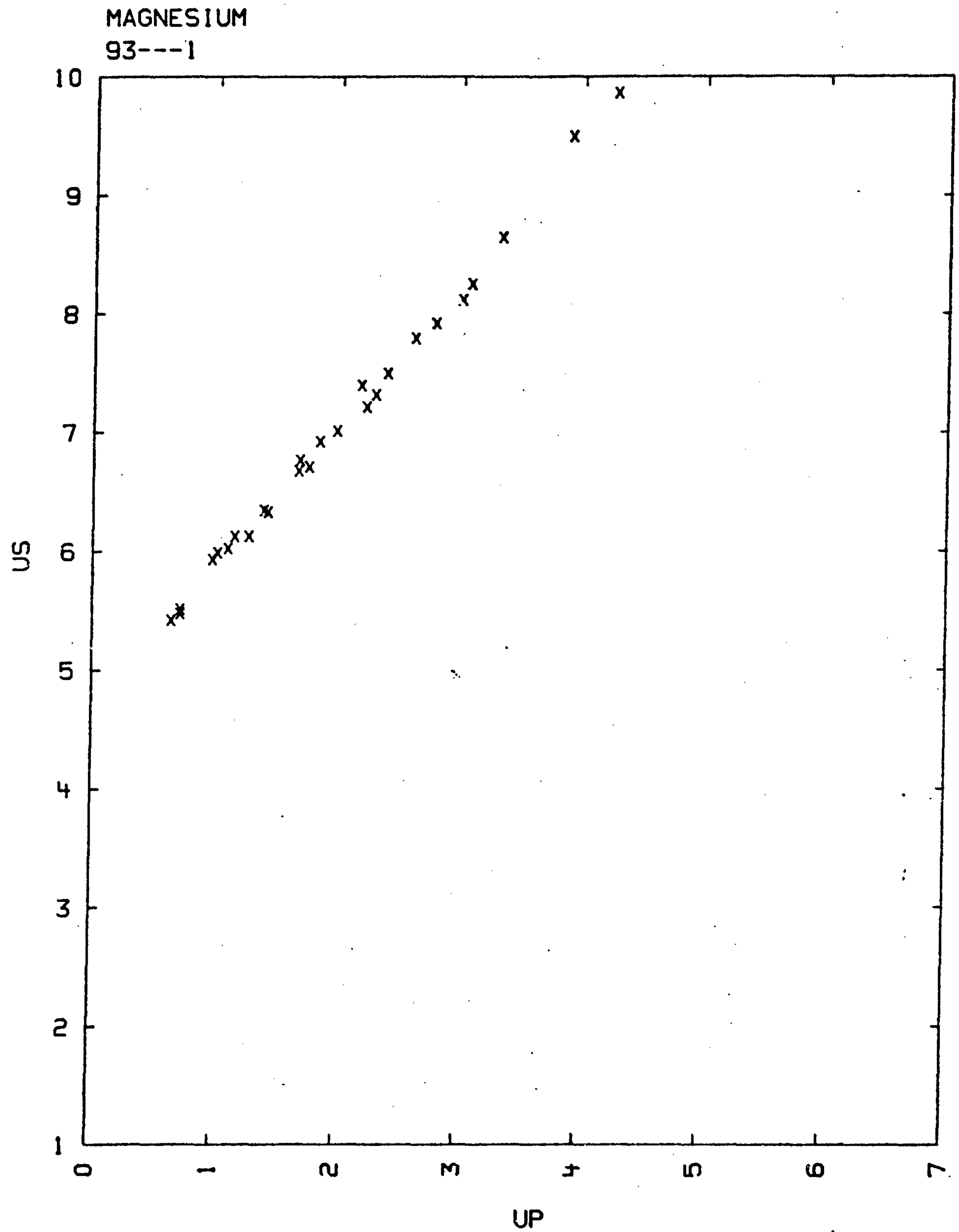
SAMPLE						BASE PLATE
RHOO	US	UFS	UP	P	V/VO	P
1.780	7.49	4.87	2.40	320	0.679	439
1.774	6.12	2.54	1.28	138	0.792	194
1.774	7.21	4.75	2.23	285	0.691	398
1.776	8.24	6.31	3.09	453	0.625	620
1.774	5.47	1.47	0.73	71	0.867	98
1.774	6.12	2.35	1.17	127	0.809	176
1.775	8.64	6.81	3.33	511	0.615	693
1.776	8.11	6.08	3.01	434	0.629	592
1.775	6.67	3.39	1.68	200	0.748	275
1.775	5.51	1.49	0.73	71	0.868	100
1.775	6.32		1.43	160	0.774	222
1.775	7.01	3.91	1.99	248	0.716	339
1.779	7.31	4.81	2.30	300	0.685	407
1.778	6.70	3.37	1.77	210	0.736	290
1.774	9.86	9.10	4.27	747	0.567	1017
1.776	7.79	5.16	2.62	361	0.664	493
1.775	5.93	1.95	0.98	103	0.834	143
1.774	6.76	3.35	1.69	202	0.750	277
1.773	7.39	4.56	2.19	287	0.704	391
1.775	7.92	5.47	2.80	394	0.646	537
1.776	6.33	2.74	1.40	157	0.779	218
1.780	5.98	2.07	1.03	110	0.828	151
1.776	5.42	1.26	0.65	62	0.881	85
1.778	9.49	8.29	3.90	658	0.589	886
1.778	6.02	2.16	1.11	119	0.816	163
1.776	6.91	3.66	1.85	226	0.732	312

US = 4.65 + 1.20 UP KM/SEC
SIGMA US = 0.008 KM/SEC

COMMENTS:

1) SOURCE: COMPILER
   L.R.L. EQUATION OF STATE FILE
   LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIFORNIA.
2) EXPERIMENTAL TECHNIQUE B. (ALUMINUM BASE PLATE)
   DATA REDUCTION TECHNIQUE B.
3) THE VALUE OF VOI WAS CALCULATED BY ASSUMING ADDITIVITY OF THE VOLUMES OF COMPONENTS. THE VOLUMES OF THE COMPONENTS WERE OBTAINED FROM A. TAYLOR AND BRENDA J. KAGLE, CRYSTALLOGRAPHIC DATA ON METAL AND ALLOY STRUCTURES (DOVER PUBLICATIONS, INC., NEW YORK, N. Y., 1963).
4) SOUND VELOCITIES WERE MEASURED BY H.L. DUNEGAN (SUPPORT ENGINEERING, ULTRASONIC GROUP) LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIF.
5) PHYSICAL PROPERTIES:
   MELTING POINT 627 DEG C
   ELECTRICAL RESISTIVITY 9.2 MICROOHM-CM
   FROM DOW METALS PRODUCTS CO. BROCHURE (1962), ON PROPERTIES OF MAGNESIUM MILL PRODUCTS. DOW CHEMICAL COMPANY, MIDLAND, MICH. U.S.A.

TABLE I



93---2
MAGNESIUM

MG

VO = 0.578 CC/G
VOI = 0.575 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN MM/MICRO-SEC, AND PRESSURE IN KILOBARS.

TABLE

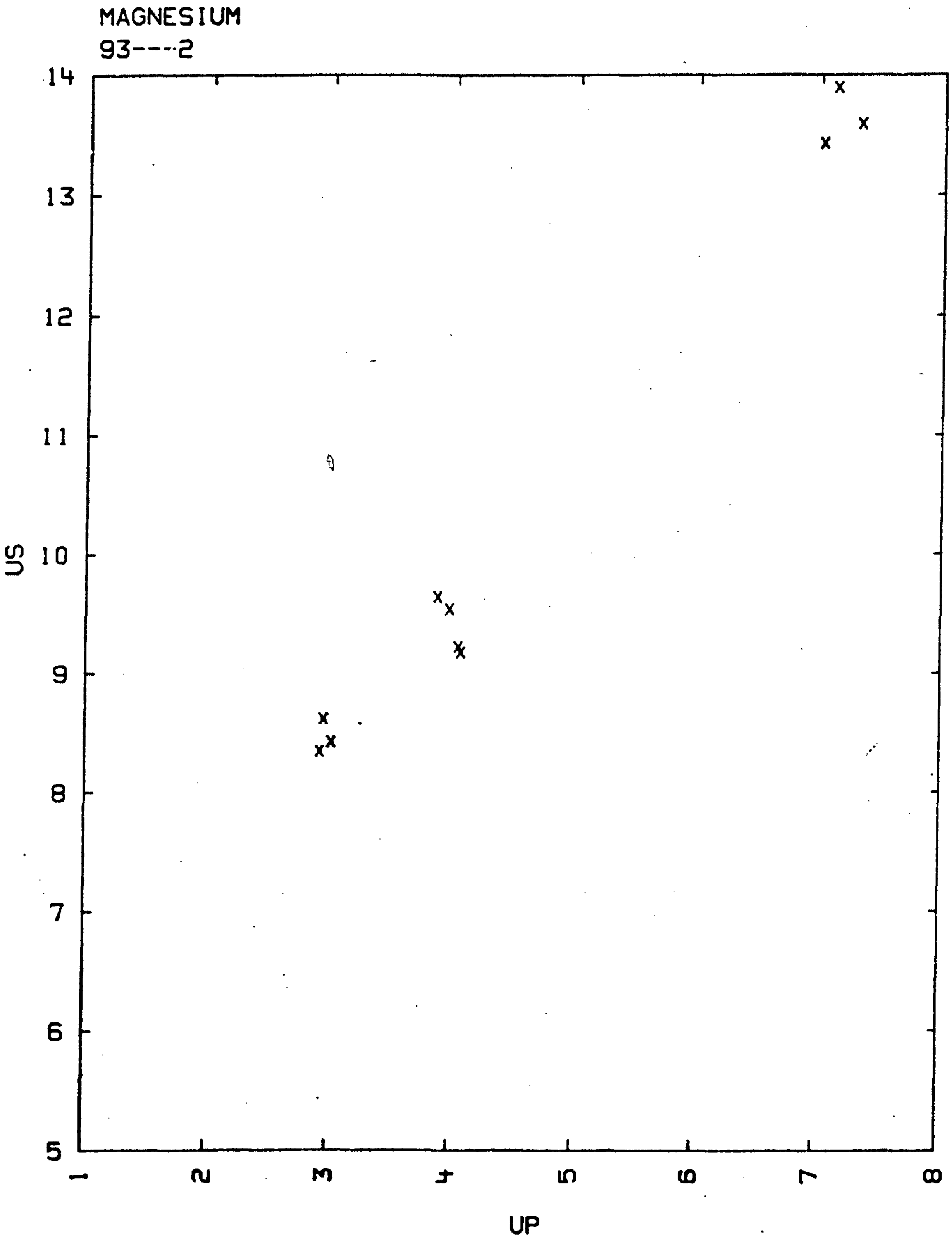
RHOO	US	UP	P	V/VO
1.73	8.34	2.93	420	.638
-	8.61	2.96	440	.657
-	8.42	3.02	440	.651
-	9.22	4.05	645	.562
-	9.18	4.08	648	.555
-	9.64	3.88	650	.600
-	9.54	3.98	660	.586
-	13.43	7.02	1630	.477
-	13.89	7.12	1710	.487
-	13.58	7.32	1720	.461

US = 4.48 + 1.273UP MM/MICROSEC

COMMENTS:

1) SOURCE: SKIDMORE, I.C. AND MORRIS, E.
THERMODYNAMICS OF NUCLEAR MATERIALS, P. 173 FF. (1962)
INTERN. AT. ENERGY AGENCY, VIENNA
ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON, ENGLAND
2) EXPERIMENTAL TECHNIQUE A
DATA REDUCTION TECHNIQUE B
THE SHOCK WAS PRODUCED BY AN EXPLOSIVELY ACCELERATED EN3 STEEL PLATE.
THE SHOCK WAS TRANSMITTED THROUGH A STEEL PLATE INTO THE SAMPLE.
3) THE VELOCITY OF THE FLYING PLATE AND THE SHOCK AND SURFACE VELOCITY OF THE TARGET PLATE WERE MEASURED AS WELL AS THE SAMPLE SURFACE AND SHOCK VELOCITIES.
4) DATA SCATTER WAS ABOUT 0.03 MICROSEC.
5) CORRECTIONS WERE MADE FOR FLYING PLATE CURVATURE OF UP TO 1 MICROSEC.
6) THE HIGHER PRESSURES WERE OBTAINED BY A SPHERICALLY CONVERGING SYSTEM.
7) ALL PELLETS WERE SURROUNDED BY LEAD TO REDUCE LATERAL RAREFACTION.

TABLE I



93---3
MAGNESIUM POROUS

MG
SPECIFIC SURFACE AREA ABOUT 1150 (SQUARE CM)/G

VO = .77 AND .575 CC/G
VOI = .575 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC, AND PRESSURE IN KILOBARS. P(ST) IS THE PRESSURE IN THE STANDARD.

TABLE

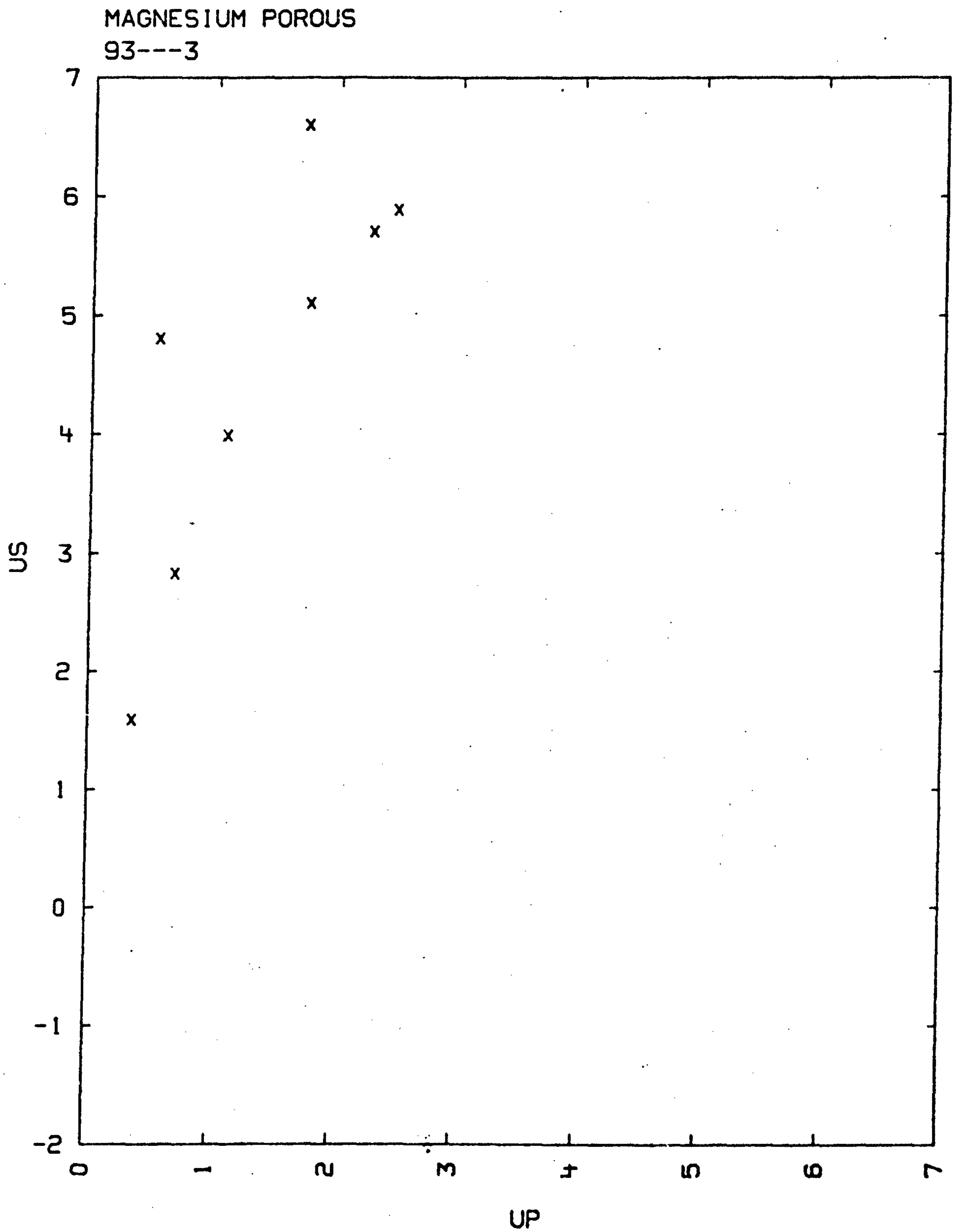
------ SAMPLE					-------	STANDARD
RHOO	US	UP	UFS	P	V/VO	P(ST)
1.3	5.88	2.48	9.2	189.	0.578	189.
-	5.70	2.28	8.0	169.	0.600	164.
-	5.10	1.78	7.2	118.	0.651	112.
-	3.98	1.11	4.8	57.	0.721	56.
-	2.82	0.69	2.34	25.	0.755	30.
-	1.58	0.36	0.48	7.	0.771	10.
1.74	6.6	1.74		200.	0.736	
-	4.80	0.54		45.	0.887	

US =

COMMENTS:

1) SOURCE: JOHNSON J.O. AND WACKERELE J.
HIGH DYNAMIC PRESSURE SYMPOSIUM, I.U.T.A.M. SEPT.11-15 1967
PARIS, FRANCE (ALSO PRIVATE COMM.)
2) EXPERIMENTAL TECHNIQUE E
DATA REDUCTION TECHNIQUE: B. STANDARD MATERIAL- LUCITE, WITH
US = 2.75 + 1.49*UP AND UP = 0.5*UFS.
3) ESTIMATED PERCENT UNCERTAINTIES FOR THE POROUS SAMPLES ARE 3.5 IN P(ST), 2.6 IN UP, 2. IN US, 2.3 IN P AND 3. IN V/VO

TABLE I



93---4
MAGNESIUM

MG 99.5 PERCENT OR GREATER

VO = 0.5731 CC/G. CL = 5.74 KM/SEC. CO = 4.44 KM/SEC.
VOI = 0.5756 CC/G. CS = 3.15 KM/SEC. CB = 4.45 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC.,
EDIT OF 24-1---1 SANDSTONE COCONINO
PRESSURE IN KILOBARS AND DENSITIES IN G/CC.

TABLE

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	RHOO	US
1.745	5.747	0.933	93.57	0.8376	2.784	6.353
-	5.733	0.934	93.44	0.8371	2.784	6.353
-	5.960	1.133	117.8	0.8099	2.785	6.571
-	5.949	1.134	117.7	0.8094	2.785	6.571
-	6.409	1.534	171.6	0.7606	2.785	7.001
-	6.361	1.538	170.7	0.7582	2.785	7.001
-	7.080	1.943	240.0	0.7256	2.285	7.485
-	6.987	1.952	238.0	0.7206	2.785	7.485
-	7.279	2.190	278.2	0.6991	2.785	7.754
-	7.231	2.195	277.0	0.6964	2.785	7.754
-	7.379	2.285	293.8	0.6907	2.784	7.857
-	7.374	2.283	293.8	0.6904	2.784	7.857
-	7.559	2.424	319.7	0.6793	2.786	8.018
-	7.635	2.479	330.3	0.6753	2.786	8.082
-	7.556	2.488	328.1	0.6707	2.786	8.082
-	8.364	3.084	450.1	0.6313	2.785	8.770
-	8.342	3.067	449.4	0.6299	2.785	8.770
-	9.414	3.821	627.7	0.5941	2.786	9.635
-	9.281	3.839	621.7	0.5864	2.786	9.635
-	9.991	4.344	757.3	0.5652	2.786	10.23
-	9.883	4.360	751.9	0.5588	2.786	10.23

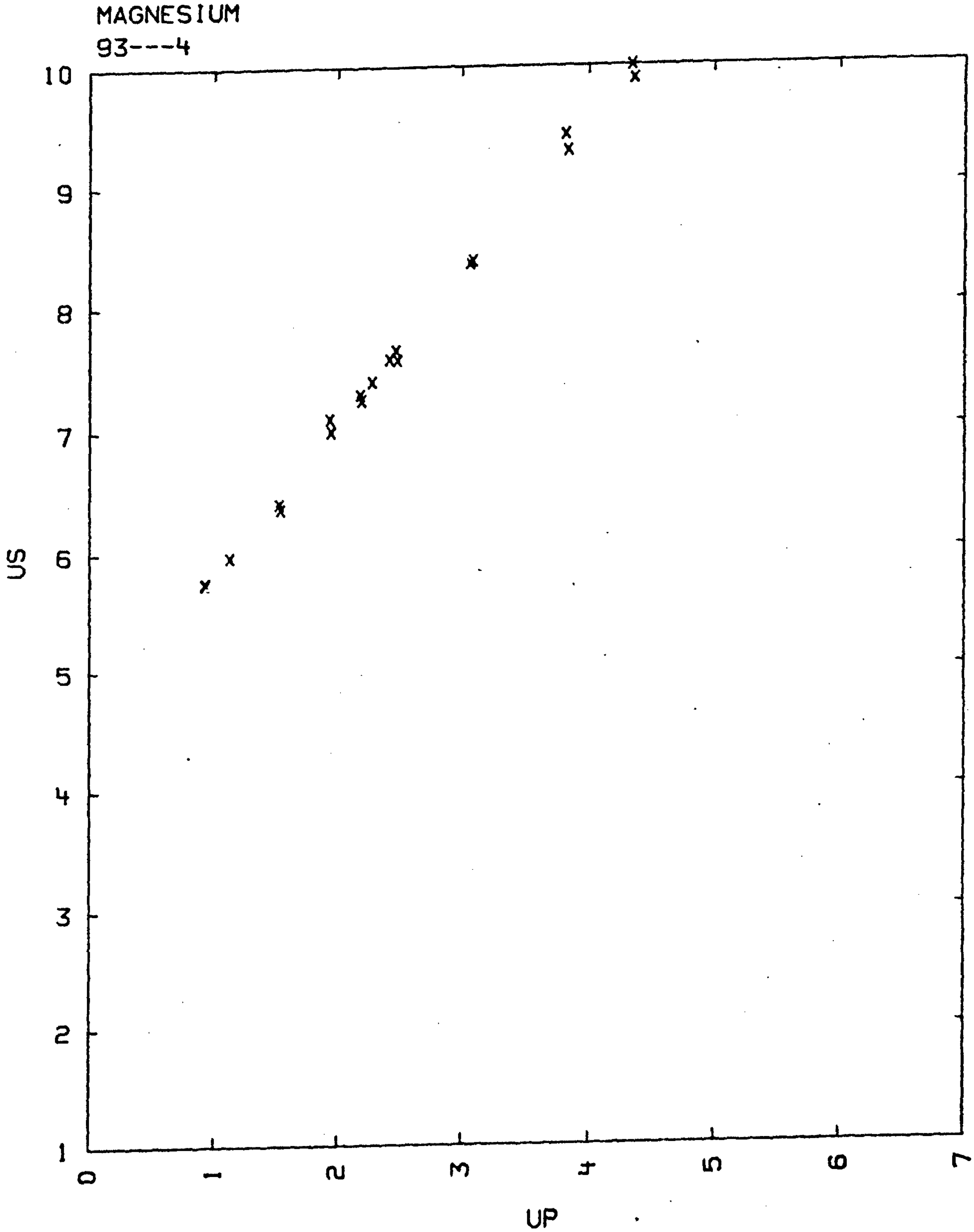
US = 4.507 + 1.255 UP

COMMENTS:

1) SOURCE: MCQUEEN, R.G. AND MARSH, S.P.
REPORT NO. GMX-6-566, PP. 51-62 (1964)
LOS ALAMOS SCIENTIFIC LABORATORY, GMX-6, LOS ALAMOS, N. MEX.
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS 2024 ALUMINUM
3) THE ALUMINUM HUGONIOT IS REPRESENTED BY
US = 5.355 + 1.345 UP KM/SEC
THE PARTIAL (DE/DP)V = 0.162 CUBIC CM. PER GRAM.
4) VOI WAS CALCULATED FROM THE LATTICE CONSTANTS

A = 3.2028 AND C = 5.19983 KX UNITS, OF THE HEXAGONAL UNIT CELL.
AMERICAN INSTITUTE OF PHYS. HANDBOOK (MCGRAW-HILL BOOK CO., N.Y., 1963) 2ND ED.

TABLE I



93---5
MAGNESIUM

MG

VO = 0.571 G/CC.
VOI = 0.5756

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

----------------SAMPLE					-----------------	-STANDARD-
RHOO	US	UFS	UP	P	V/VO	UFS
1.75	7.042	3.974	1.970	243.	0.720	
-	7.153	3.937	1.920	240	0.732	
-	6.944	3.655	1.825	222	0.737	
-	6.802	3.844	1.910	227	0.719	
-	6.830	3.526	1.760	210	0.742	
-	6.973	3.686	1.835	224	0.732	
-	6.711		1.891	222	0.718	3.080
-	6.811		1.879	224	0.724	3.060
-	6.702		1.880	220.5	0.719	3.060
-	6.803		1.865	222	0.726	3.050
-	6.501		1.772	202	0.727	2.870
-	6.640		1.732	201	0.739	2.830
-	6.527		1.681	192	0.742	2.710
-	6.493		1.716	195	0.736	2.780
-	6.765		1.580	187	0.767	2.600
-	6.631		1.607	186.5	0.758	2.630
-	6.435		1.522	172	0.763	2.480
-	6.501		1.623	185.5	0.750	2.640
-	6.443		1.575	178.5	0.756	2.565
-	6.289		1.645	181.5	0.738	2.650
-	6.369		1.513	168	0.762	2.445
-	6.402		1.508	169	0.764	2.445
-	6.172		1.564	159	0.747	2.495
-	6.195		1.555	168	0.749	2.480
-	6.188		1.509	163	0.756	2.415
-	6.273		1.545	170	0.754	2.495
-	6.443		1.460	165	0.773	2.390
-	6.257		1.514	165	0.758	2.430
-	6.060		1.367	145	0.774	2.200
-	6.150		1.384	149	0.775	2.200
-	6.195		1.328	144	0.786	2.150
-	6.195		1.365	148	0.780	2.200
-	6.134		1.146	123	0.813	1.870
-	5.938		1.169	121.5	0.803	1.880
-	5.720		1.213	121.5	0.788	1.950
-	6.038		1.202	127	0.801	1.930
-	5.307		0.888	82.5	0.833	1.390
-	5.530		0.884	85.5	0.840	1.405
-	5.446		0.840	80	0.846	1.315

MAGNESIUM

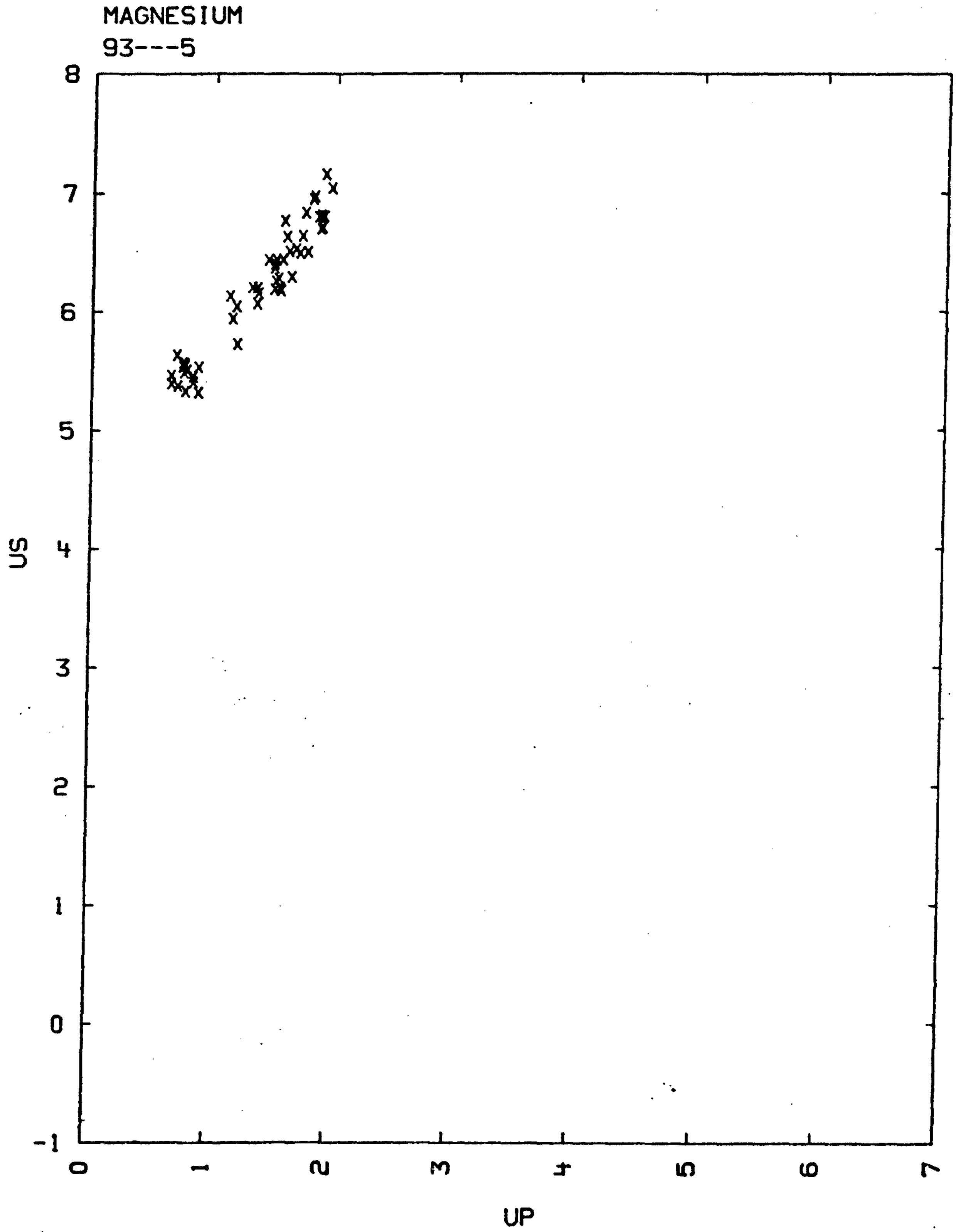
RHOO	US	UFS	UP	P	V/VO	UFS
-	5.399		0.845	79	0.843	1.325
-	5.509		0.793	76.5	0.856	1.260
-	5.509		0.792	76	0.856	1.255
-	5.561		0.773	75	0.861	1.240
-	5.537		0.763	74	0.862	1.210
-	5.561		0.760	74	0.863	1.210
-	5.488		0.765	73.5	0.861	1.220
-	5.324		0.774	72	0.855	1.215
-	5.524		0.752	73	0.864	1.205
-	5.636		0.707	70	0.875	1.135
-	5.364		0.713	67	0.867	1.125
-	5.393		0.660	62	0.878	1.040
-	5.458		0.656	63	0.880	1.060

US = 4.529 + 1.212 UP KM/SEC.

COMMENTS:

1) SOURCE: BERGER J. AND FAUQUIGNON C.
PRIVATE COMMUNICATION (1964), B.P. NO. 7, SEVRAN, FRANCE
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL ALUMINUM AU4G
3) SAMPLE DIMENSIONS FOR THE US MEASUREMENTS: 2.0 CM DIAMETER
0.5 CM THICKNESS
SAMPLE DIMENSIONS FOR THE UFS MEASUREMENTS: 2.0 CM DIAMETER
0.25 CM THICKNESS
4) VOI WAS CALCULATED FROM THE CONSTANTS, A = 3.2028 AND C = 5.19983
UNITS, OF THE HEXAGONAL UNIT CELL.
AMERICAN INSTITUTE OF PHYS. HANDBOOK (MCGRAW-HILL BOOK CO., N.Y.
1963) 2ND ED.

TABLE I



93---6
MAGNESIUM

MG 96 PERCENT BY WEIGHT
ZN 3 PERCENT - -
ZR 1 PERCENT - -

V0 = 0.556 CC/G.
V0I = 0.5756 CC/G.

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC., VELOCITIES IN KM/SEC., AND PRESSURE IN KILOBARS.

TABLE

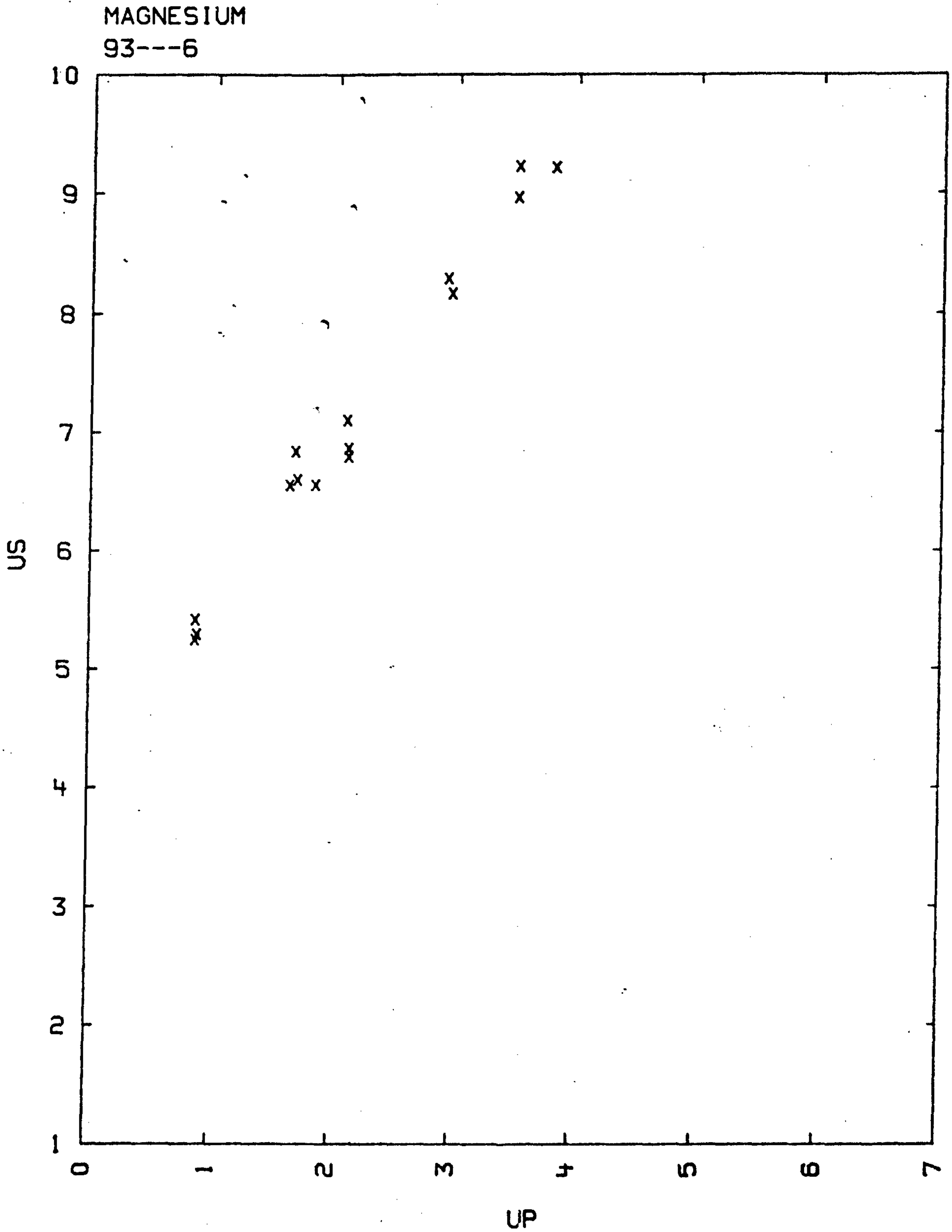
RHO0	US	UP	P	V/V0
1.80	5.24	0.86	81	0.836
-	5.29	0.87	83	0.836
-	5.42	0.86	84	0.841
-	6.55	1.63	192	0.751
-	6.60	1.69	201	0.744
-	6.83	1.67	205	0.756
-	6.55	1.84	217	0.719
-	6.79	2.11	258	0.689
-	6.86	2.11	260	0.692
-	7.10	2.10	268	0.704
-	8.16	2.96	435	0.637
-	8.29	2.93	437	0.647
-	8.96	3.51	566	0.608
-	9.22	3.52	284	0.618
-	9.21	3.82	633	0.585

US = 4.40 + 1.274 UP KM/SEC.

COMMENTS:

1) SOURCE: HART AND SKIDMORE
PRIVATE COMMUNICATION (1965)
ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON, BERKSHIRE, ENGLAND.
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
STANDARD MATERIAL FE AND BRASS.
3) V0I WAS CALCULATED FOR PURE MAGNESIUM USING THE LATTICE CONSTANTS A = 3.20280 AND C = 5.19983 KX UNITS, OF THE HEXAGONAL UNIT CELL A.C.A. MONOGRAPH NUMBER 5(AMERICAN CRYSTALLOGRAPHIC ASSOCIATION, POLYCRYSTAL BOOK SERVICE 1963) 2ND. ED.
4) THE ABOVE US-UP FIT WHICH WAS OBTAINED BY USING IDEAL MIXTURE THEORY ON THE HUGONIOTS OF THE COMPONENTS IN THE P-V PLANE, IS IN AGREEMENT WITH THE TABULATED DATA.

TABLE I



93---7
MAGNESIUM

MG

VO = 0.575 CC/G   CO = 4.39 KM/SEC
VOI = 0.57562 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

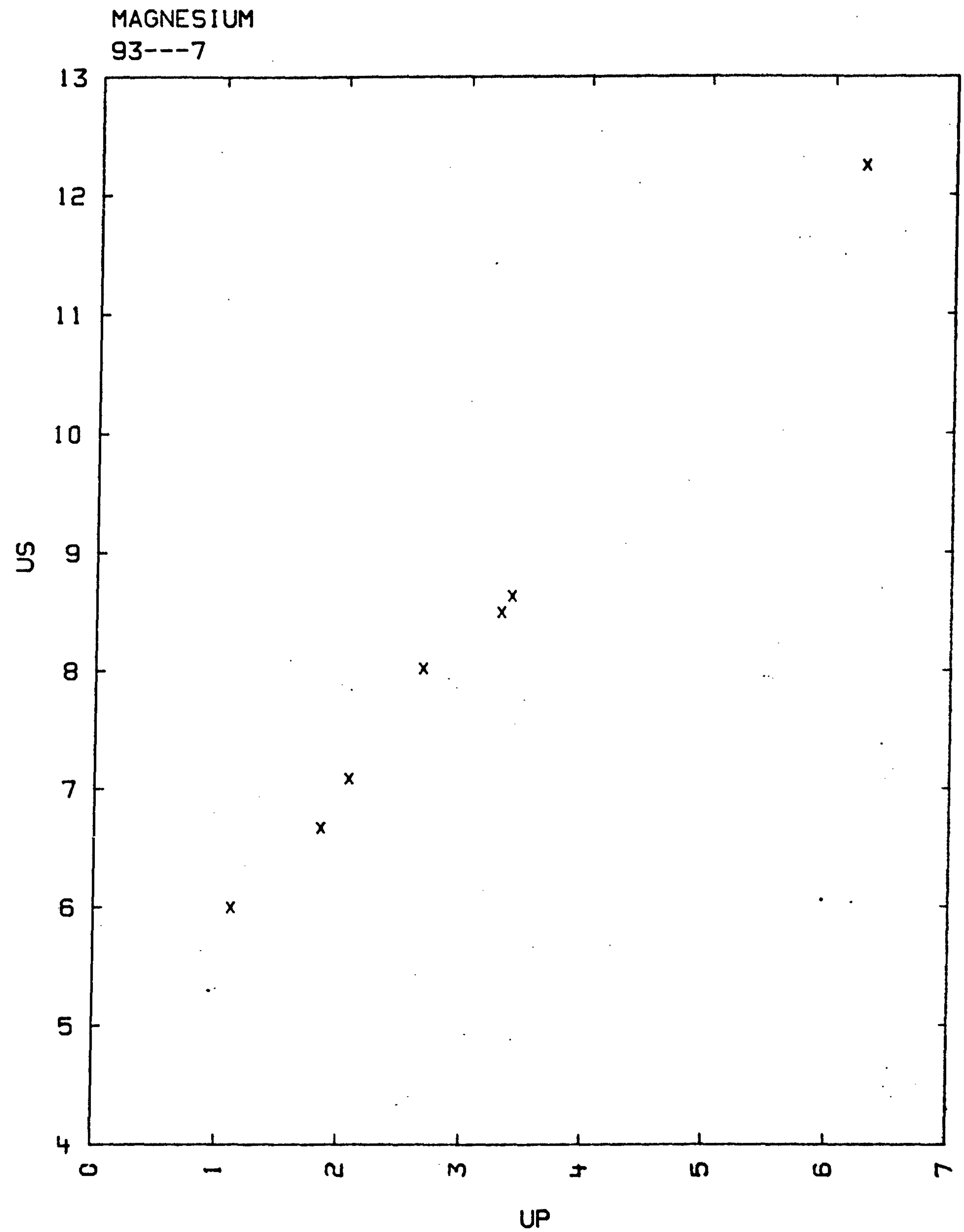
SAMPLE					STANDARD		
RHOO	US	UP	P	V/VO	MATERIAL	RHOO(ST)	US(ST)
1.74	12.24	6.25	1330.	0.489			
-	8.63	3.39	509.	0.607	ALUMINUM	2.71	9.17
-	8.49	3.30	487.	0.611			
-	8.02	2.67	372.	0.667			
-	7.08	2.08	256.	0.706			
-	6.66	1.85	214.4	0.722	ALUMINUM	2.71	6.21
-	5.99	1.12	116.7	0.813			

US = 4.41 + 1.27*UP KM/SEC FOR UP BELOW 6.25 KM/SEC

COMMENTS:

1) SOURCE: ALTSHULER, L. V., BAKANOVA, A. A., DUDOLADOV, I. P.
ZHURNAL EKXP. TEOREDT FIZIKI V. 53, P. 1967 (1967).
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) ONLY SHOCK VELOCITIES WERE MEASURED TO DETERMINE THE STRESS STATES. THE UNCERTAINTY IN THE SHOCK VELOCITIES WAS ESTIMATED TO BE 1.0 PERCENT.
4) HUGONIOTS OF STANDARD MATERIALS USED WERE AS FOLLOWS
ALUMINUM US = 5.25 + 1.39*UP FOR UP BETWEEN 0.0 AND 6.0 KM/SEC
5) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANTS OF THE HEXAGONAL CLOSE-PACKED STRUCTURE.
A = 3.20927 ANGSTROMS, C = 5.21033 ANGSTROMS (25 DEG. C)
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SIDNEY, 1963) 2ND EDITION, VOL. 1, P. 11.
6) THE AUTHORS OBTAINED THE VALUE OF CO FROM HANDBOOK OF RARE METALS, (MIR PUBLISHERS, USSR, 1963) OR FROM C. KITTEL, INTRODUCTION TO SOLID STATE PHYSICS (FIZMATGIZ, USSR, 1963).

TABLE I



93---8
MAGNESIUM

MG
GRAIN SIZE 5. MM MAX

VO = 0.5731-0.5764 CC/G CC = 5.74 KM/SEC CO = 4.44 KM/SEC
VOI = 0.5756 CC/G CS = 3.15 KM/SEC CB = 4.45 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

-----SAMPLE-----					-----STANDARD-----	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
1.745	5.66	0.88	87.	0.8445	2024 AL	6.26
1.745	5.65	0.88	87.	0.8442	2024 AL	6.26
1.745	5.87	1.08	111.	0.8160	2024 AL	6.48
1.735	5.91	1.08	111.	0.8173	2024 AL	6.48
1.745	5.86	1.08	110.	0.8157	2024 AL	6.48
1.734	6.12	1.20	127.	0.8039	2024 AL	6.61
1.734	6.28	1.34	146.	0.7866	2024 AL	6.77
1.734	6.24	1.37	148.	0.7804	2024 AL	6.80
1.745	6.32	1.47	162.	0.7674	2024 AL	6.91
1.770	6.15	1.48	161.	0.7593	2024 AL	6.91
1.745	6.27	1.48	162.	0.7640	2024 AL	6.91
1.741	6.38	1.58	175.	0.7524	921-T AL	6.86
1.745	6.98	1.88	229.	0.7307	2024 AL	7.38
1.745	6.89	1.89	227.	0.7257	2024 AL	7.38
1.734	7.01	1.93	235.	0.7247	2024 AL	7.43
1.734	6.76	1.93	226.	0.7145	2024 AL	7.41
1.734	6.87	1.95	232.	0.7162	2024 AL	7.43
1.735	7.00	2.03	247.	0.7100	2024 AL	7.53
1.745	7.17	2.12	265.	0.7043	2024 AL	7.64
1.745	7.13	2.13	265.	0.7013	2024 AL	7.64
1.740	7.11	2.14	265.	0.6990	921-T AL	7.52
1.734	7.25	2.15	270.	0.7034	2024 AL	7.67
1.745	7.27	2.21	280.	0.6960	2024 AL	7.74
1.745	7.27	2.21	280.	0.6960	2024 AL	7.74
1.745	7.45	2.35	306.	0.6846	2024 AL	7.90
1.745	7.52	2.41	316.	0.6795	2024 AL	7.97
1.745	7.45	2.42	315.	0.6752	2024 AL	7.97
1.745	8.24	3.01	433.	0.6347	2024 AL	8.64
1.745	8.22	3.01	432.	0.6338	2024 AL	8.64
1.734	8.83	3.36	514.	0.6195	2024 AL	9.06
1.734	8.85	3.36	516.	0.6203	2024 AL	9.06
1.734	8.79	3.37	514.	0.6166	2024 AL	9.06
1.734	9.03	3.50	548.	0.6124	2024 AL	9.23
1.734	8.93	3.51	544.	0.6069	2024 AL	9.22
1.735	9.04	3.72	583.	0.5885	2024 AL	9.45
1.745	9.28	3.73	604.	0.5981	2024 AL	9.50
1.745	9.15	3.75	599.	0.5902	2024 AL	9.50
1.734	9.75	4.02	680.	0.5877	2024 AL	9.84

MAGNESIUM

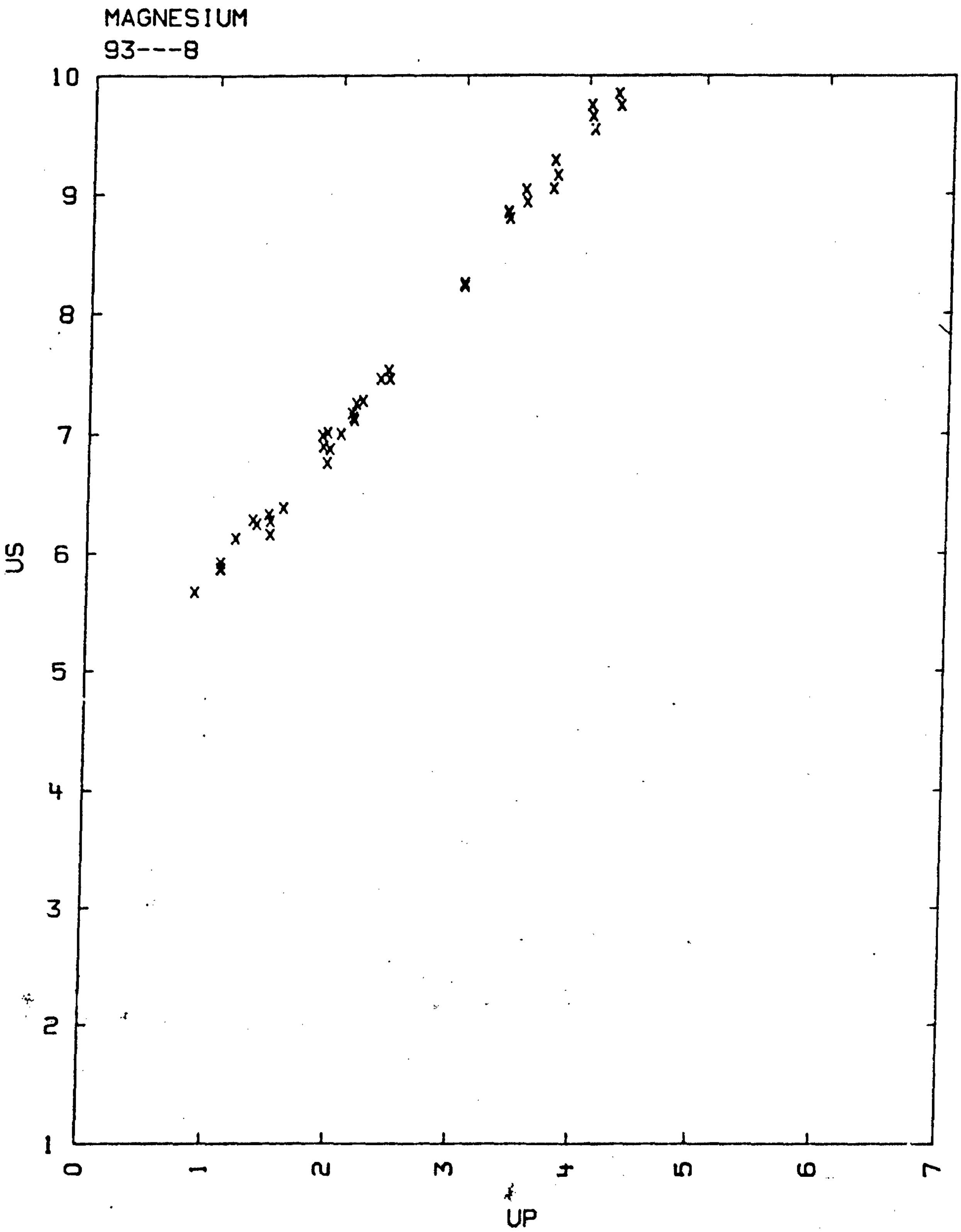
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
1.734	9.65	4.03	674.	0.5824	2024 AL	9.83
1.734	9.54	4.05	670.	0.5755	2024 AL	9.83
1.745	9.85	4.25	731.	0.5685	2024 AL	10.08
1.745	9.74	4.27	726.	0.5616	2024 AL	10.08

US = 4.492 + 1.263·UP KM/SEC
SIGMA US = 0.089 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES, HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII
2) EXPERIMENTAL TECHNIQUE: B
DATA REDUCTION TECHNIQUE: B
3) V0I FROM WYCKOFF, CRYSTAL STURCTURES (INTERSCIENCE PUBLISHERS, N.Y., 1963) V. 1
4) V(DP/DE) = 1.425

TABLE I



93---9
MAGNESIUM AZ-31B

MG	96.0 WT PERCENT
AL	3.0 WT PERCENT
ZN	1.0 WT PERCENT

VO = 0.562-0.565 KM/SEC CL = 5.73 KM/SEC CO = 4.52 KM/SEC
VOI = 0.565 KM/SEC CS = 3.05 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

SAMPLE					STANDARD	
RHOO	US	UP	P	V/VO	MATERIAL	US(ST)
1.770	5.53	0.39	38.	0.9295	CU	4.31
1.780	5.30	0.60	57.	0.8868	2024 AL	5.96
1.770	5.35	0.60	57.	0.8879	2024 AL	5.96
1.770	5.33	0.61	58.	0.8856	2024 AL	5.98
1.770	5.36	0.64	61.	0.8806	921-T AL	5.76
1.780	5.52	0.82	81.	0.8514	2024 AL	6.20
1.770	5.60	0.83	82.	0.8518	2024 AL	6.22
1.770	5.95	1.12	118.	0.8118	2024 AL	6.53
1.780	5.91	1.12	118.	0.8105	2024 AL	6.53
1.770	5.93	1.13	119.	0.8094	2024 AL	6.54
1.770	5.96	1.22	129.	0.7953	921-T AL	6.43
1.780	6.28	1.42	159.	0.7739	2024 AL	6.87
1.770	6.39	1.47	166.	0.7700	2024 AL	6.92
1.770	7.00	2.03	252.	0.7100	2024 AL	7.55
1.780	7.04	2.04	256.	0.7102	2024 AL	7.56
1.770	7.14	2.04	258.	0.7143	921-T AL	7.43
1.770	7.09	2.07	260.	0.7080	2024 AL	7.60
1.780	7.12	2.12	269.	0.7022	2024 AL	7.65
1.770	7.66	2.53	343.	0.6697	2024 AL	8.12
1.780	7.70	2.60	356.	0.6623	2024 AL	8.19
1.780	8.23	3.02	442.	0.6330	2024 AL	8.67
1.780	8.54	3.29	500.	0.6148	2024 AL	8.98
1.780	8.72	3.36	522.	0.6147	2024 AL	9.08
1.780	9.13	3.71	603.	0.5936	2024 AL	9.48
1.780	9.63	4.05	694.	0.5794	2024 AL	9.88
1.780	10.00	4.14	737.	0.5860	2024 AL	10.03

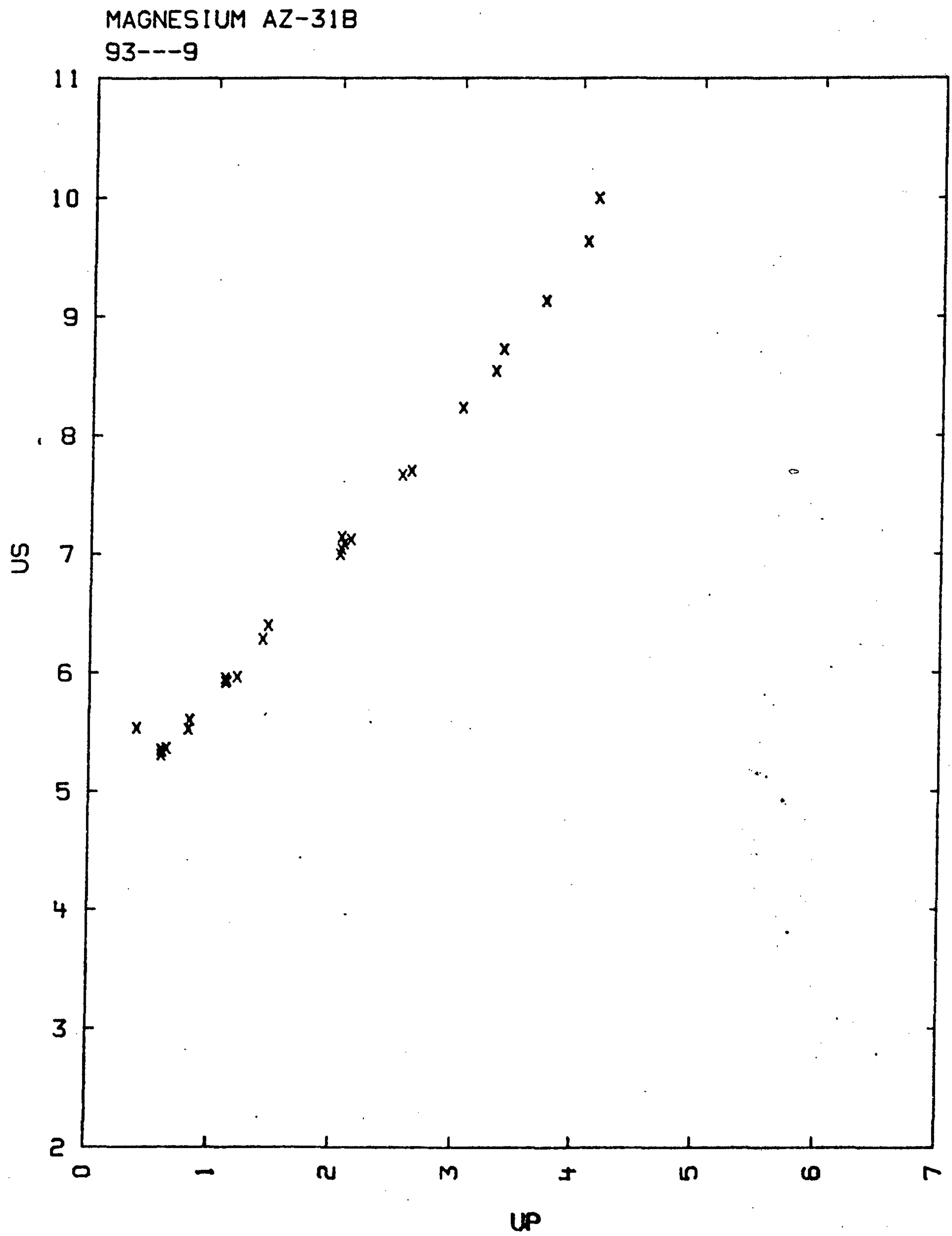
US = 4.522 + 1.242*UP KM/SEC
SIGMA US = 0.128 KM/SEC

COMMENTS:

1) SOURCE: MCQUEEN, R.G., MARSH, S.P., TAYLOR, J.W., FRITZ, J.M., AND CARTER, W.J.
THE EQUATION OF STATE OF SOLIDS FROM SHOCK WAVE STUDIES, HIGH VELOCITY IMPACT PHENOMENA, KINSLOW (ED.) (ACADEMIC PRESS, NEW YORK, 1970) CHAPTER VII

2) EXPERIMENTAL TECHNIQUE: B
DATA REDUCTION TECHNIQUE: B
3) VOI AS FOR 93---1
4) V(DP/DE) = 1.434
5) HUGCNIOT ELASTIC LIMIT 1.1 KBAR

TABLE I



93---10
MAGNESIUM, AZ31B ALLOY

MG	96.	WT.	PERCENT	NOMINAL
AL	3.	-	-	-
ZN	1.	-	-	-

V0 = 0.564 CC/G
V0I= 0.565 -

THE TABLE LISTS RHO0 IN G/CC, VELOCITIES IN KM/SEC AND P IN KBARS.
MG= MAGNESIUM, CU= COPPER, FS= FANSTEEL AND WF= WEIGHTING FACTOR.

TABLE

SAMPLE					IMPACTOR		
RHO0	US	UP	P	V/V0	MAT	U	WF
1.773	6.731	1.769	211.	.7372	MG	3.539	3
1.773	8.020	2.956	420.	.6314	MG	5.911	3
1.773	10.884	4.959	957.	.5444	CU	6.631	1
1.773	12.221	6.388	1384.	.4773	FS	7.795	3

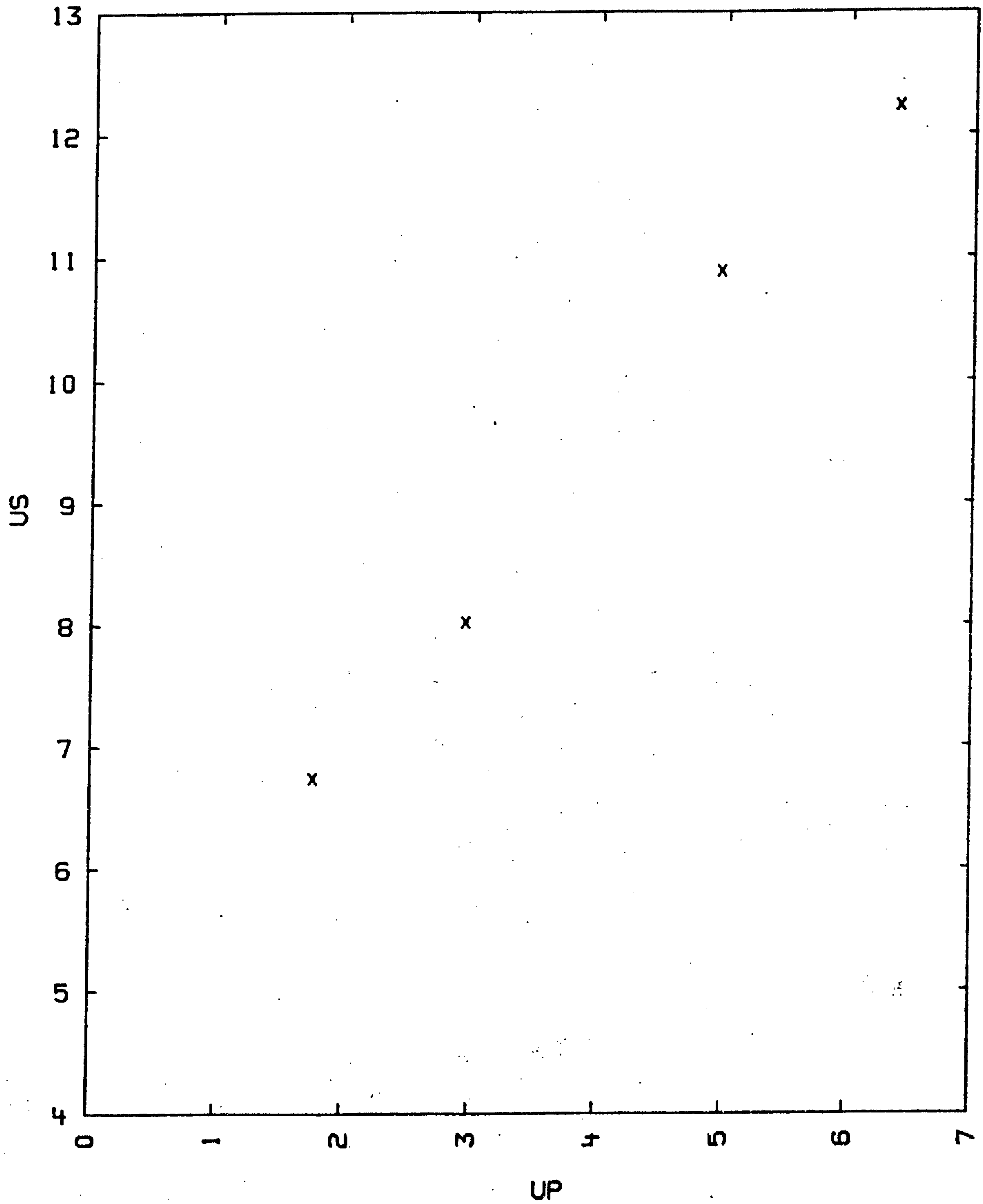
US = 4.551 + 1.209*UP KM/SEC
SIG.US = 0.083 KM/SEC

COMMENTS:

1) SOURCE: ISBELL W.M., SHIPMAN F.H. AND JONES A.H.
HUGONIOT EQUATION OF STATE OF ELEVEN MATERIALS TO FIVE MBARS.
MATERIALS SCIENCE LABORATORY REPORT: MSL-68-13
2) EXPERIMENTAL TECHNIQUE: A
DATA REDUCTION METHOD : A
3) NOMINAL UNCERTAINTIES ARE (SIG.US)/US = .005 AND (SIG.U)/U = .005
4) V0I WAS TAKEN FROM ENTRY 93---1

TABLE I

MAGNESIUM, AZ31B ALLOY
93---10



94---1
CALCIUM

CA

VO = 0.656 CC/G
VOI = 0.6536 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN KM/SEC AND PRESSURE IN KILOBARS.

TABLE

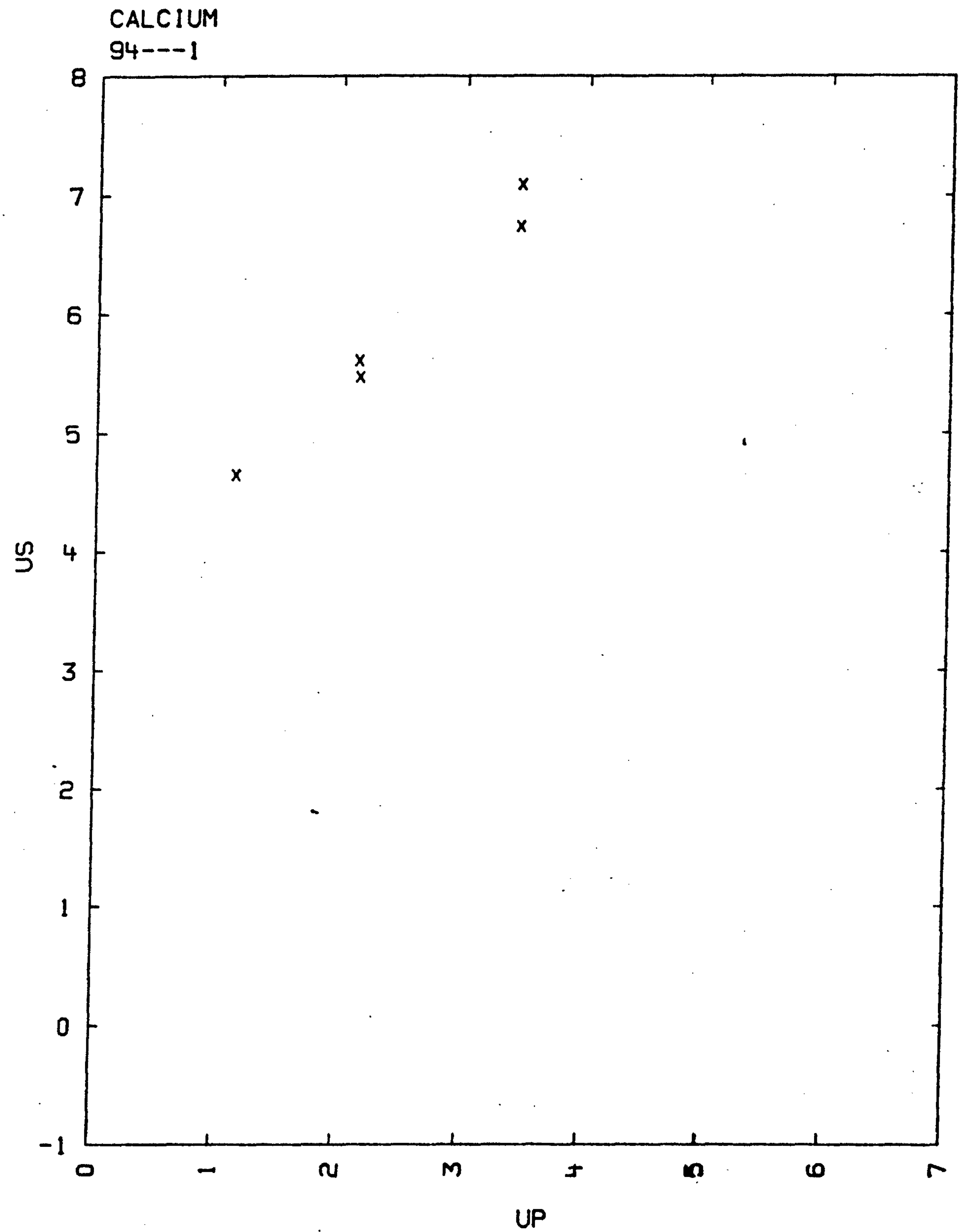
	SAMPLE					AL BASE PLATE
RHOO	US	UFS	UP	P	V/VO	PRESSURE
1.523	5.61	4.29	2.15	183	0.618	324
1.523	5.47	4.16	2.16	178	0.605	324
1.527	4.64	2.22	1.15	81	0.753	146
1.526	6.73	7.79	3.44	354	0.489	618
1.524	7.09	6.87	3.45	353	0.488	618

US = 3.58 + 0.91 UP KM/SEC
SIGMA US = 0.062 KM/SEC

COMMENTS:

1) SOURCE: COMPILER
L.R.L. EQUATION OF STATE FILE
LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIFORNIA.
2) EXPERIMENTAL TECHNIQUE B. STANDARD MATERIAL 2024 AL ALLOY.
DATA REDUCTION TECHNIQUE B.
3) THE VALUE OF VOI WAS OBTAINED FROM A. TAYLOR AND BRENDA J. KAGLE, CRYTSTALLOGRAPHIC DATA ON METAL AND ALLOY STRUCTURES (DOVER PUBLICATIONS, INC., NEW YORK, N. Y., 1963).

TABLE I



94---2
CALCIUM

CA

VO = 0.658 CC/G
VOI = 0.6513 CC/G

CO = 3.36 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

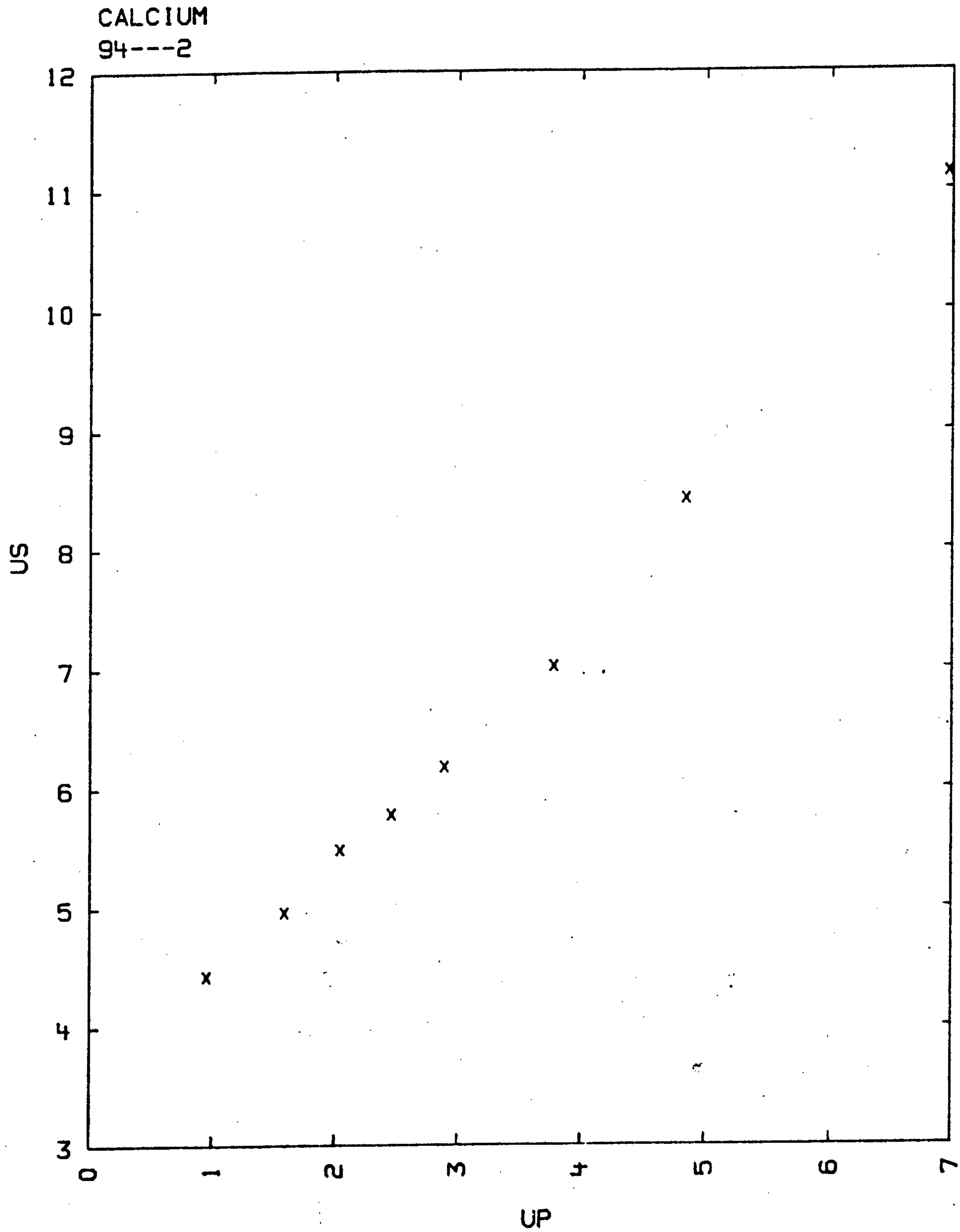
SAMPLE					STANDARD		
RHOO	US	UP	P	V/VO	MATERIAL	RHOO(ST)	US(ST)
1.52	11.13	6.96	1178.	0.375	IRON	7.85	11.21
-	8.42	4.84	619.	0.425	IRON	7.85	8.83
-	7.02	3.77	402.	0.463	ALUMINUM	2.71	9.17
-	6.18	2.89	271.	0.532			
-	5.78	2.46	216.	0.574			
-	5.48	2.04	170.	0.628	ALUMINUM	2.71	7.34
-	4.96	1.59	120.	0.679			
-	4.43	0.96	64.6	0.783	ALUMINUM	2.71	6.21

US = 3.55 + 0.912*UP KM/SEC FOR UP BELOW 3.71 KM/SEC
US = 2.08 + 1.308*UP KM/SEC FOR UP BETWEEN 3.71 AND 6.96 KM/SEC

COMMENTS:

1) SOURCE: ALTSHULER, L. V., BAKANOVA, A. A., DUDOLADOV, I. P.
ZHURNAL EKSP. TEORET. FIZIKI V. 53, P. 1967 (1967).
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) ONLY SHOCK VELOCITIES WERE MEASURED TO DETERMINE THE STRESS STATES. THE UNCERTAINTY IN THE SHOCK VELOCITIES WAS ESTIMATED TO BE 1.0 PERCENT.
4) HUGONIOTS OF STANDARD MATERIALS USED WERE AS FOLLOWS
ALUMINUM US = 5.25 + 1.39*UP FOR UP BETWEEN 0.0 AND 6.0 KM/SEC
IRON US = 3.85 + 1.615*UP FOR UP BETWEEN 1.0 AND 4.6 KM/SEC
5) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANT OF THE CUBIC CLOSE-PACKED STRUCTURE,
A = 5.576 ANGSTROMS
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SIDNEY, 1963) 2ND EDITION, VOL. 1, P. 10.
6) THE AUTHORS OBTAINED THE VALUE OF CO FROM HANDBOOK OF RARE METALS, (MIR PUBLISHERS, USSR, 1963) OR FROM C. KITTEL, INTRODUCTION TO SOLID STATE PHYSICS (FIZMATGIZ, USSR, 1963).
7) THE DISCONTINUITY OF THE US VS. UP PLOT AT UP = 3.71 KM/SEC IS ATTRIBUTED TO AN ELECTRONIC PHASE CHANGE.

TABLE I



95---1
STRONTIUM

SR

VO = 0.385 CC/G
VOI = 0.38711 CC/G

CO = 2.11 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

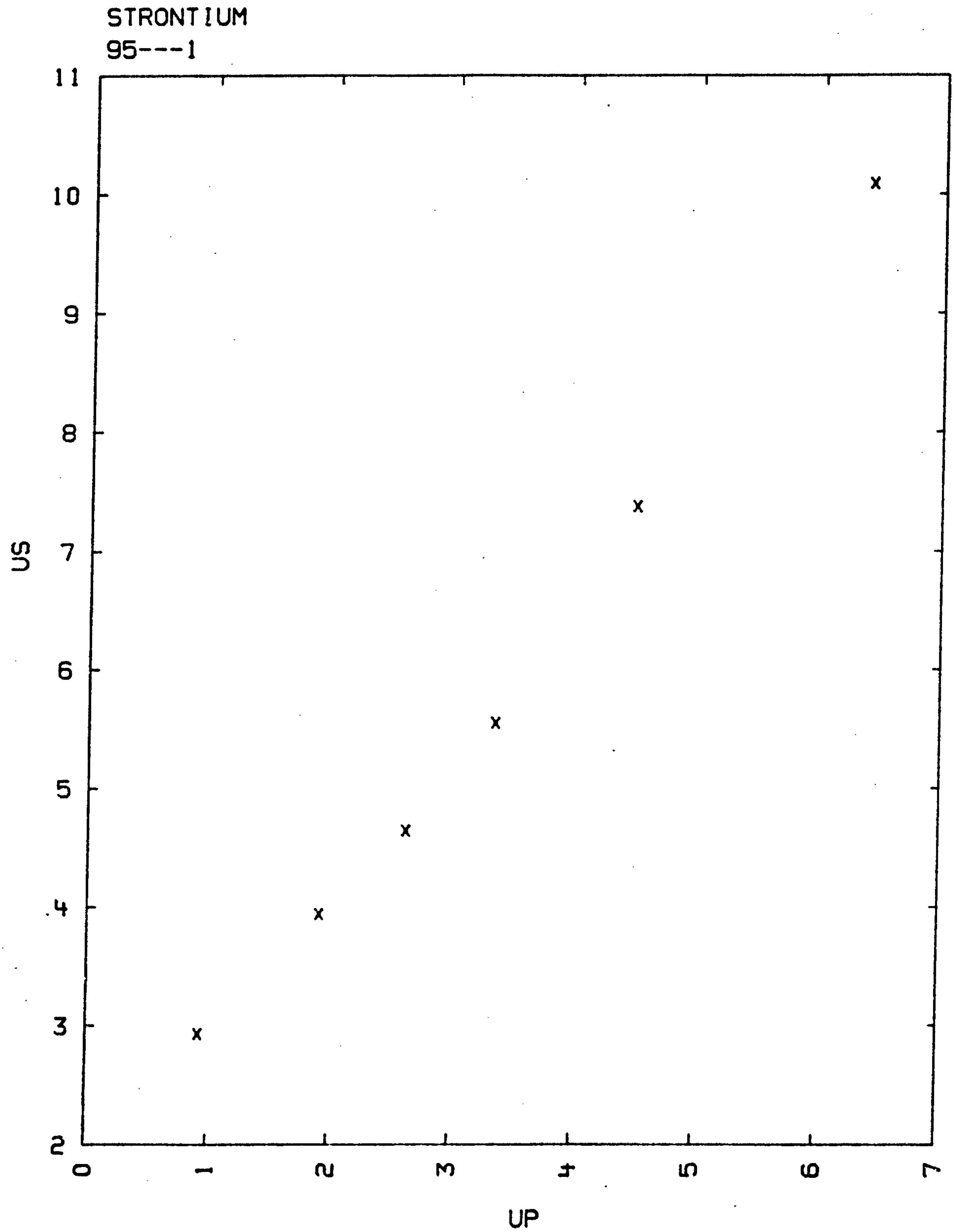
SAMPLE					STANDARD		
RHOO	US	UP	P	V/VO	MATERIAL	RHOO(ST)	US(ST)
2.60	10.08	6.40	1677.	0.365	IRON	7.85	11.21
-	7.37	4.49	860.	0.391	IRON	7.85	8.83
-	5.55	3.35	483.	0.396	ALUMINUM	2.71	9.17
-	4.64	2.63	317.	0.433	COPPER	8.93	6.45
-	3.94	1.92	196.7	0.513	ALUMINUM	2.71	7.34
-	2.93	0.93	70.8	0.683	ALUMINUM	2.71	6.21

US = 2.10 + 0.94*UP KM/SEC FOR UP BELOW 2.71 KM/SEC
US= 0.58 + 1.50*UP KM/SEC FOR UP BETWEEN 2.71 AND 6.40 KM/SEC

COMMENTS:

1) SOURCE: ALTSHULER, L. V., BAKANOVA, A. A., DUDOLADOV, I. P.
ZHURNAL EKSP- TEORET. FIZIKI V. 53, P. 1967 (1967).
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) ONLY SHOCK VELOCITIES WERE MEASURED TO DETERMINE THE STRESS STATES. THE UNCERTAINTY IN THE SHOCK VELOCITIES WAS ESTIMATED TO BE 1.0 PERCENT.
4) HUGONIOTS OF STANDARD MATERIALS USED WERE AS FOLLOWS
ALUMINUM US = 5.25 + 1.39*UP FOR UP BETWEEN 0.0 AND 6.0 KM/SEC
COPPER US = 3.95 + 1.50*UP FOR UP BETWEEN 0.0 AND 4.0 KM/SEC
IRON US = 3.85 + 1.615*UP FOR UP BETWEEN 1.0 AND 4.6 KM/SEC
5) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANT OF THE CUBIC CLOSE-PACKED STRUCTURE,
A = 6.0847 ANGSTOMS (25 DEG. C)
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON. SIDNEY, 1963) 2ND EDITION, VOL. 1, P. 10.
6) THE AUTHORS OBTAINED THE VALUE OF CO FROM HANDBOOK OF RARE METALS, (MIR PUBLISHERS, USSR, 1963) OR FROM C. KITTEL, INTRODUCTION TO SOLID STATE PHYSICS (FIZMATGIZ, USSR, 1963).
7) THE DISCONTINUITY OF THE US VS. UP PLOT AT UP = 2.71 KM/SEC IS ATTRIBUTED TO AN ELECTRONIC PHASE CHANGE.

TABLE I



96---1
BARIUM

BA

VO = 0.275 CC/G
VOI = 0.2782 CC/G

CO = 1.66 KM/SEC

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN KM/SEC, PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

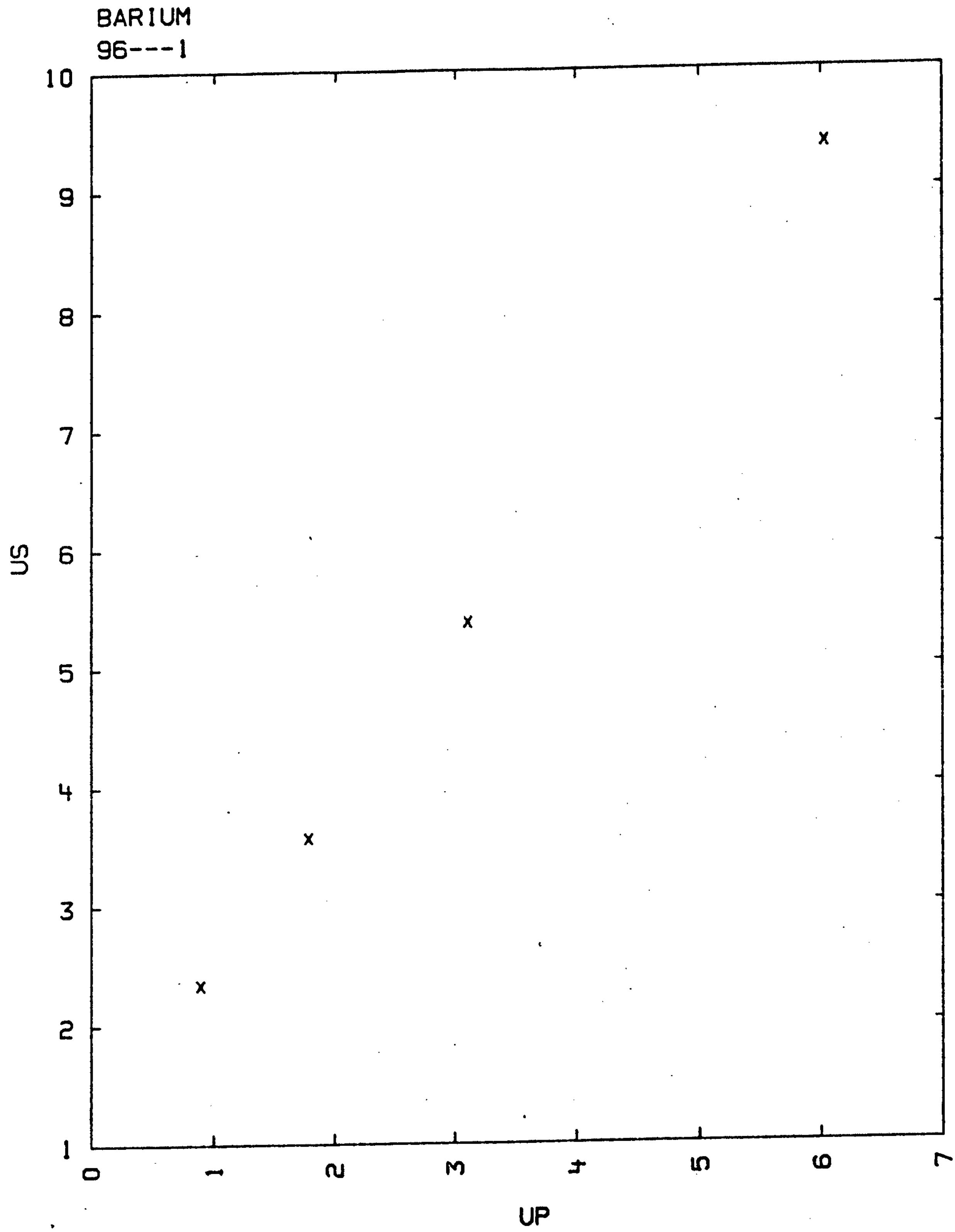
SAMPLE					STANDARD		
RHO0	US	UP	P	V/V0	MATERIAL	RHO0(ST)	US(ST)
3.63	9.36	6.03	2049.	0.356	IRON	7.85	11.21
-	5.37	3.11	606.	0.421	ALUMINUM	2.71	9.17
-	3.56	1.79	231.	0.497	ALUMINUM	2.71	7.34
-	2.34	0.90	76.4	0.615	ALUMINUM	2.71	6.21

US =1.11 + 1.366*UP KM/SEC FOR UP BETWEEN 0.9 AND 6.03 KM/SEC

COMMENTS:

1) SOURCE: ALTSHULER, L.V., BAKANOVA, A. A., DUDOLADOV, I. P.
ZHURNAL EKSP. TEORET. FIZIKI V. 53, P. 1967 (1967).
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) ONLY SHOCK VELOCITIES WERE MEASURED TO DETERMINE THE STRESS STATES. THE UNCERTAINTY IN THE SHOCK VELOCITIES WAS ESTIMATED TO BE 1.0 PERCENT.
4) HUGONIOTS OF STANDARD MATERIALS USED WERE AS FOLLOWS
ALUMINUM US = 5.25 + 1.39*UP FOR UP BETWEEN 0.0 AND 6.0 KM/SEC
IRON US = 3.85 + 1.615*UP FOR UP BETWEEN 1.0 AND 4.6 KM/SEC
5) THE VALUE OF VOI WAS OBTAINED FROM THE FOLLOWING LATTICE CONSTANT OF THE CUBIC BODY-CENTERED STRUCTURE,
A = 5.025 ANGSTROMS (26 DEG. C)
WYCKOFF, R. W. G., CRYSTAL STRUCTURES (INTERSCIENCE PUBLISHERS, NEW YORK, LONDON, SIDNEY, 1963) 2ND EDITION, VOL. 1, P. 16.
6) THE AUTHORS OBTAINED THE VALUE OF CO FROM HANDBOOK OF RARE METALS, (MIR PUBLISHERS, USSR, 1963) OR FROM C. KITTEL, INTRODUCTION TO SOLID STATE PHYSICS (FIZMATGIZ, USSR, 1963).

TABLE I



98---1
LITHIUM

LI

VO = 1.887 CC/G CO = 4.69 KM/SEC.
VOI = 1.873 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

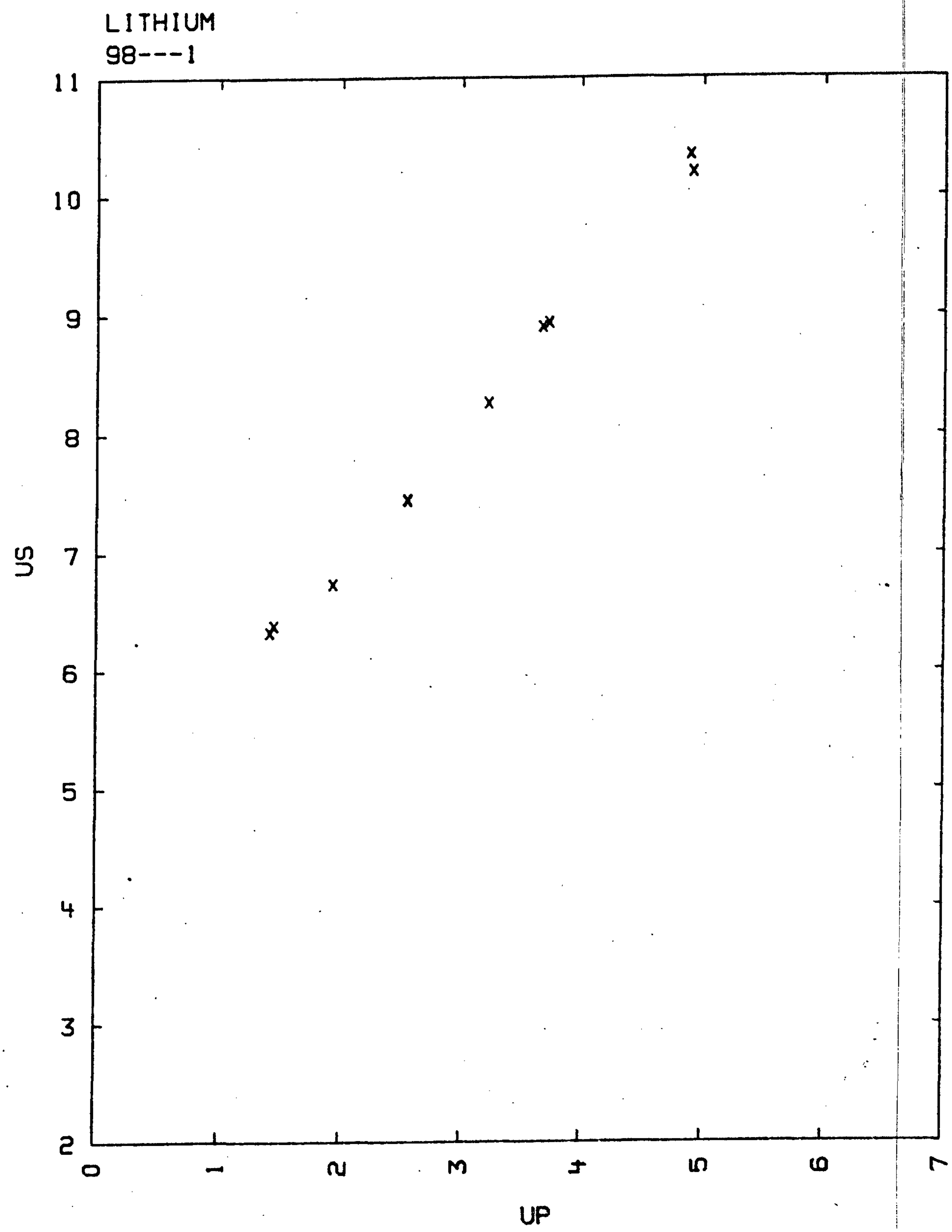
RHOO	US	UP	P	V/VO
0.530	6.329	1.425	47.8	0.7748
-	6.382	1.457	49.3	0.7717
-	6.734	1.941	69.3	0.7118
-	7.433	2.554	100.6	0.6564
-	7.449	2.553	100.8	0.6573
-	8.251	3.231	141.3	0.6084
-	8.893	3.679	173.4	0.5863
-	8.929	3.727	176.4	0.5826
-	10.192	4.908	265.1	0.5184
-	10.335	4.887	267.7	0.5271

US = 4.589 + 1.154 UP KM/SEC.

COMMENTS:

1) SOURCE: RICE, M. H.
J. PHYS. CHEM. SOLIDS, VOL. 26, P. 483 (1965)
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL IS 2024 ALUMINUM
3) CO IS CALCULATED BY USING A BULK MODULUS OF 11.49 E 10 DYNE/CM**2.
C. KITTEL, INTRODUCTION TO SOLID STATE PHYSICS, 1D ED,
JOHN WILEY AND SONS, INC., NEW YORK, 1956.
4) VOI WAS TAKEN FROM THE A. I. P. HANDBOOK (MCGRAW-HILL BOOK CO.) 2ND ED.

TABLE I



98---2
LITHIUM

LI

VO = 1.69 CC/G
VOI = 1.876 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN KM/SEC, AND PRESSURE IN KILOBARS.

TABLE

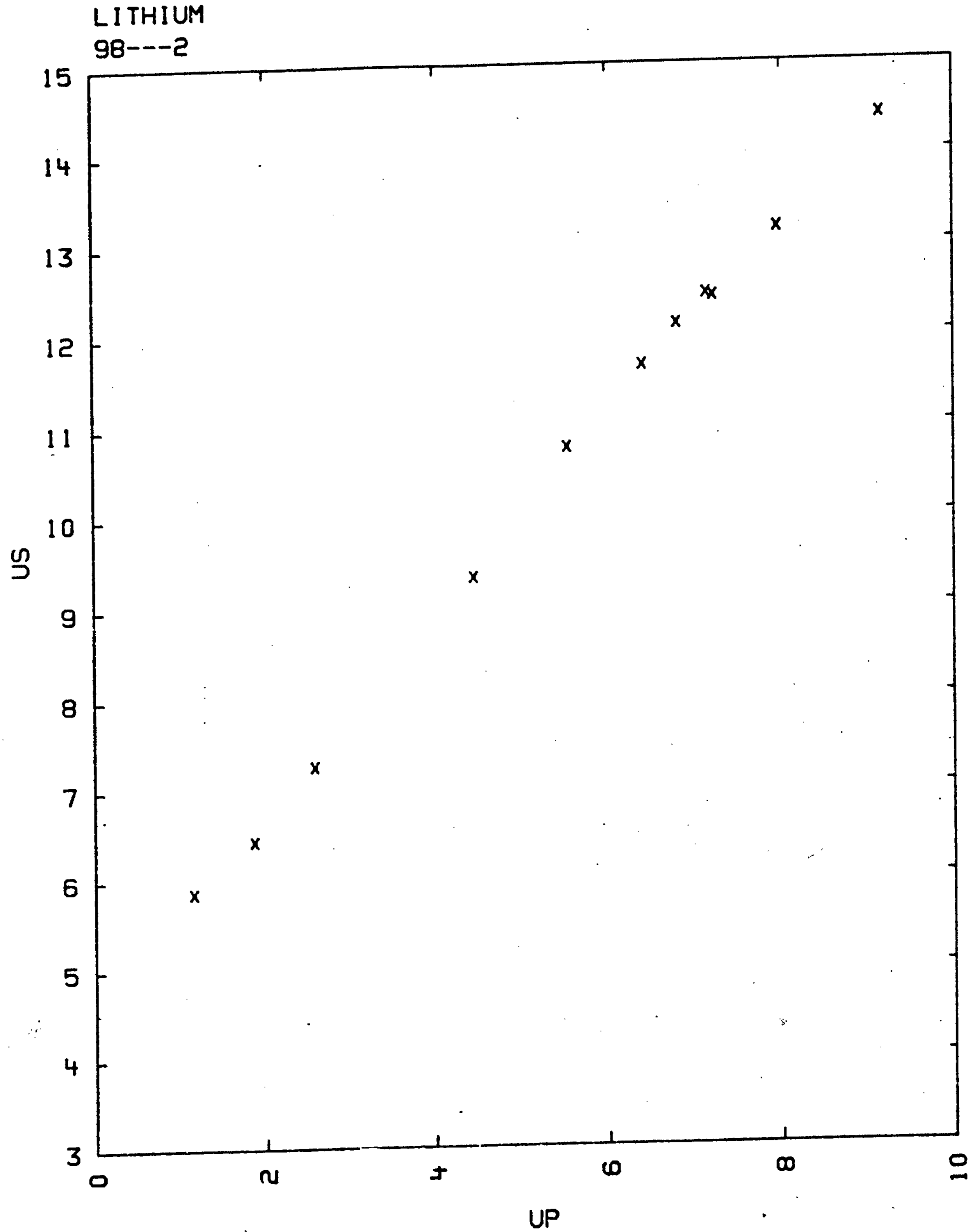
SAMPLE					BASE PLATE	
RHOO	US	UP	P	V/VO	MATERIAL	UP
0.53	5.86	1.14	35	0.806	AL	0.69
-	6.43	1.87	64	0.709	AL	1.14
-	7.25	2.59	100	0.641	AL	1.60
-	9.32	4.45	220	0.521	AL	2.82
-	10.75	5.54	316	0.485	PLEXIGLAS	4.51
-	11.64	6.42	396	0.448	PLEXIGLAS	5.21
-	12.10	6.81	437	0.437	PLEXIGLAS	5.53
-	12.43	7.15	471	0.426	PLEXIGLAS	5.80
-	12.40	7.23	475	0.417	PLEXIGLAS	5.85
-	13.14	7.97	555	0.394	PLEXIGLAS	6.44
-	14.39	9.15	698	0.364	PLEXIGLAS	7.38

US = 4.51 + 1.09 UP KM/SEC
SIGMA US = 0.123 KM/SEC

COMMENTS:

1) SOURCE: BAKANOVA, A.A., DUDOLADOV, I.P., TRUNIN, R. F.
FIZIKA TVERDOGO TELA, VOL. 7, NO. 6, PP. 1616 - 1622 (1965).
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) THE FOLLOWING HUGONIOT RALATIONSHIPS FOR THE BASE PLATE WERE USED:
AL STANDARD US = 5.25 + 1.39 UP KM/SEC RHOO = 2.71 G/CC
PLEXIGLAS US = 3.10 + 1.32 UP KM/SEC RHOO = 1.18 G/CC (FOR US EQUAL OR GRATER THAN 6.0 KM/SEC).
4) OTHER LISTED LI PARAMETERS:
AT 300 DEG. K
RHOO 0.53 G/CC
COMPRESSIBILITY 9.12 PER MEGABAR
GRUNEISEN COEF 0.90
AT 0.0 DEG. K
RHOO 0.544 G/CC
COMPRESSIBILITY 7.9 PER MEGABAR
ELECTRONIC HEAT CAPACITY 2520 ERG/G DEG. SQUARE
5) THE VALUE OF VOI WAS OBTAINED FROM A. TAYLOR AND BRENDA J. KAGLE, CRYSTALLOGRAPHIC DATA ON METAL AND ALLOY STRUCTURES (DOVER PUBLICATIONS, INC., NEW YORK, N. Y., 1963).

TABLE I



98---3
LITHIUM

LI

VO = 1.87 CC/G
VOI = 1.876 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN KM/SEC, AND PRESSURE IN KILOBARS.

TABLE

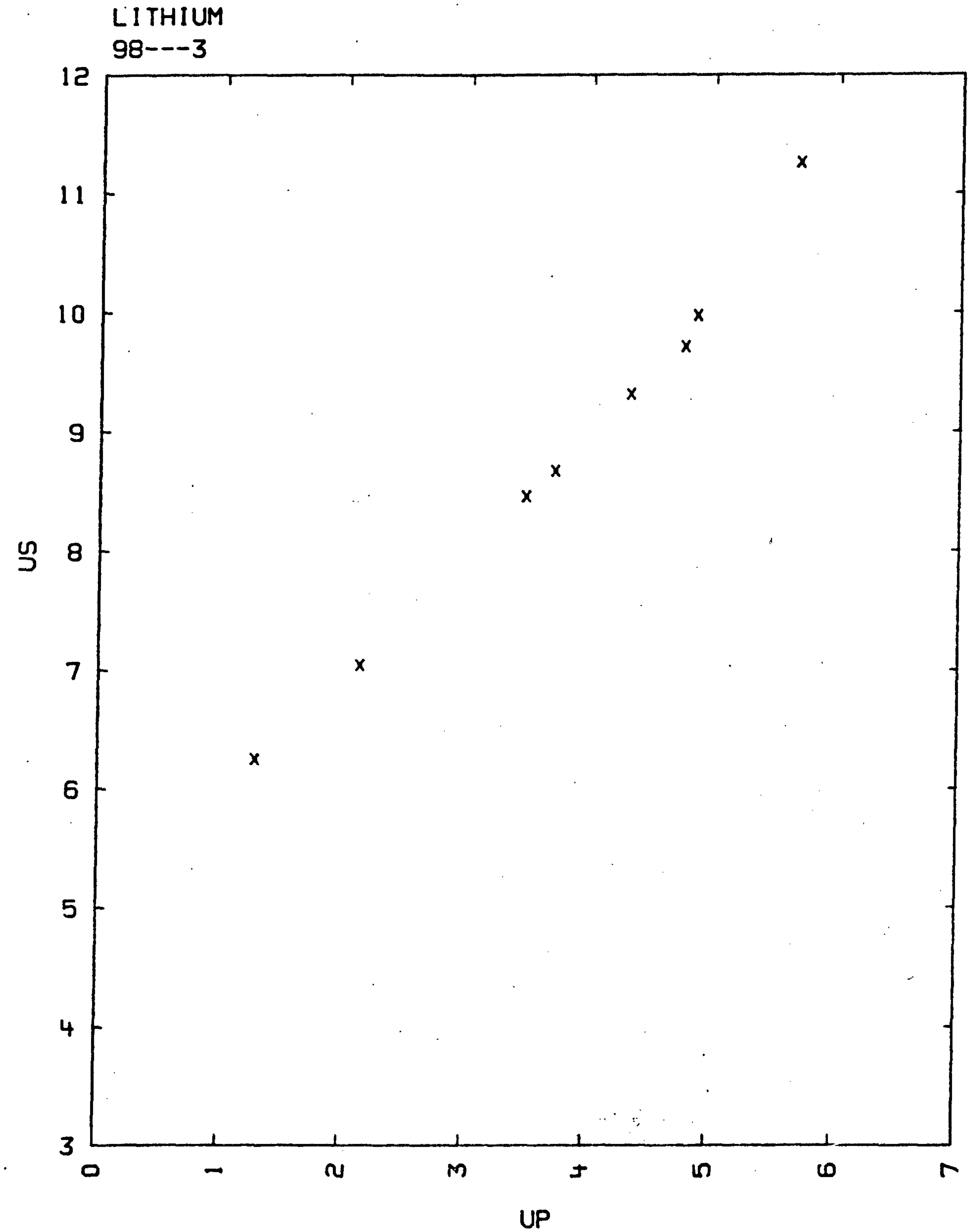
SAMPLE						BASE PLATE
RHOO	US	UFS	UP	P	V/VO	PRESSURE
0.537	9.71		4.77	250	0.509	773
0.533	7.04	4.28	2.14	80	0.696	257
0.531	6.25	2.59	1.29	43	0.794	140
0.534	11.26	10.53	5.68	342	0.496	1017
0.533	8.45		3.48	157	0.588	493
0.533	8.66	6.69	3.72	172	0.570	537
0.533	9.97	8.65	4.87	259	0.510	796
0.533	9.31	8.10	4.33	215	0.535	670

US = 4.66 + 1.11 UP KM/SEC
SIGMA US = 0.232 KM/SEC

COMMENTS:

1) SOURCE: COMPILER
L.R.L. EQUATION OF STATE FILE
LAWRENCE RADIATION LABORATORY, LIVERMORE, CALIFORNIA.
2) EXPERIMENTAL TECHNIQUE B (ALUMINUM STANDARD BASE PLATE).
DATA REDUCTION TECHNIQUE B.
3) THE VALUE OF VOI WAS OBTAINED FROM A. TAYLOR AND BRENDA J. KAGLE, CRYSTALLOGRAPHIC DATA ON METAL AND ALLOY STRUCTURES (DOVER PUBLICATIONS, INC., NEW YORK, N. Y., 1963).

TABLE I



99---0
SODIUM SUMMARY

NA

VO = 0.1033 CC/G
VOI= 0.1034 CC/G

CO = 2.33 KM/SEC

THE TABLE LISTS HUGONIOT POINTS CALCULATED FROM THE FIT GIVEN BELOW. UNITS ARE: G/CC, KM/SEC, KBAR AND KBAR.CC/G FOR THE ENERGY DIFFERENCE.

TABLE

RHOO	US	UP	P	V/VO	E-EO
0.967	3.777	1.0	36.5	0.735	5.00
-	5.037	2.0	97.4	0.603	20.0
-	6.297	3.0	183.	0.523	45.0
-	7.557	4.0	292.	0.471	80.0
-	10.077	6.0	585.	0.404	180.
-	12.597	8.0	974.	0.365	320.

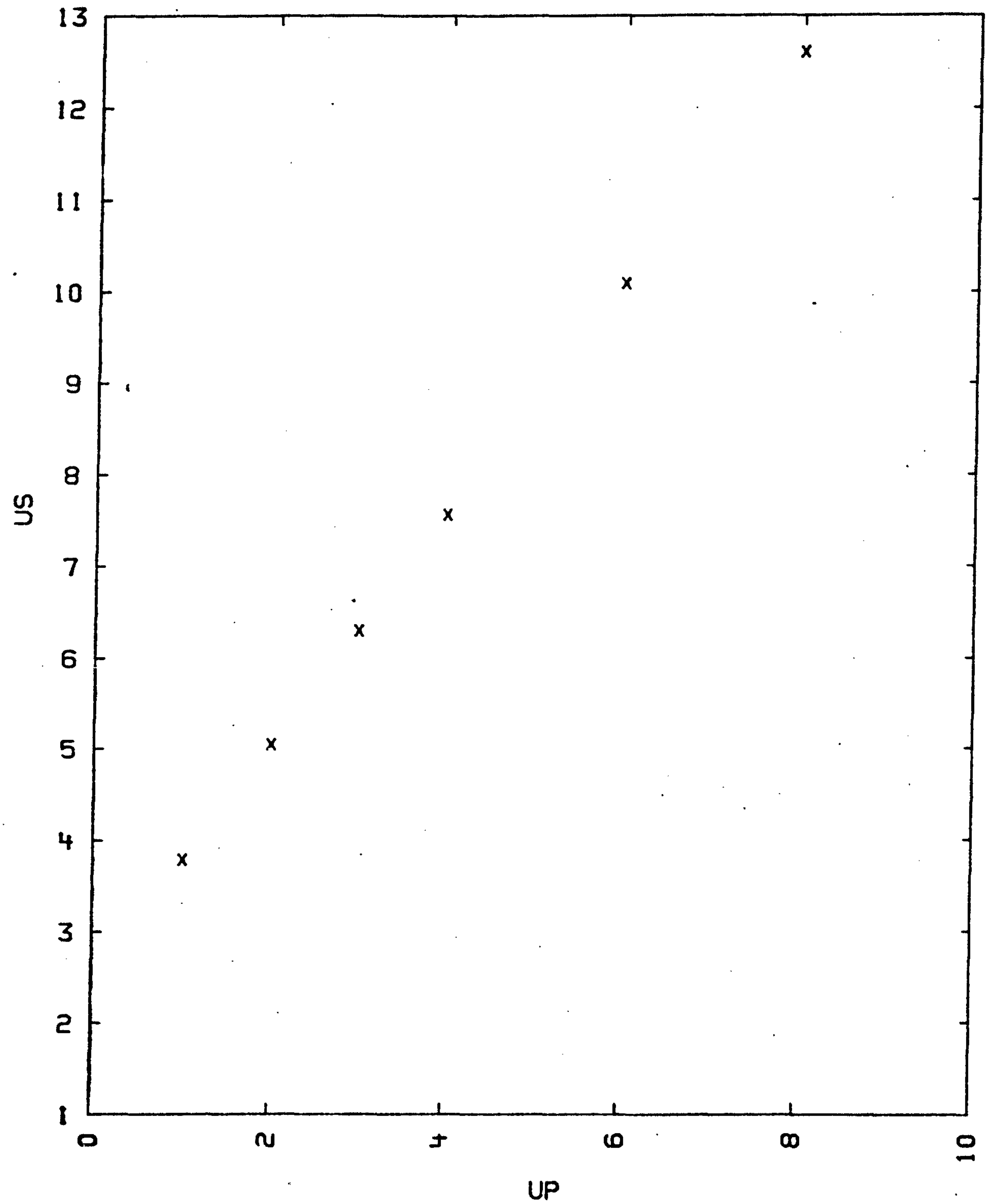
US = 2.517 + 1.260*UP, SIG. US = 0.06 KM/SEC
FOR UP BETWEEN 1 AND 8 KM/SEC.

COMMENTS:

1) SOURCE: COMPILER
1A) THE DATA OF 99---1 AND 2 WERE USED FOR THIS FIT.
2) VOI AND CO CALCULATED AS IN 99---1
3) SEE ALSO THE ZERO PRESSURE PROPERTIES IN COMMENT 4 PAGE 99---2

TABLE I

SODIUM SUMMARY
99---0



99---1
SODIUM

NA

VO = 1.033 CC/G
VOI = 1.034 CC/G.

CO = 2.33 KM/SEC.

IN THE TABLE BELOW, VELOCITIES ARE GIVE IN MM/MICROSEC.
PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

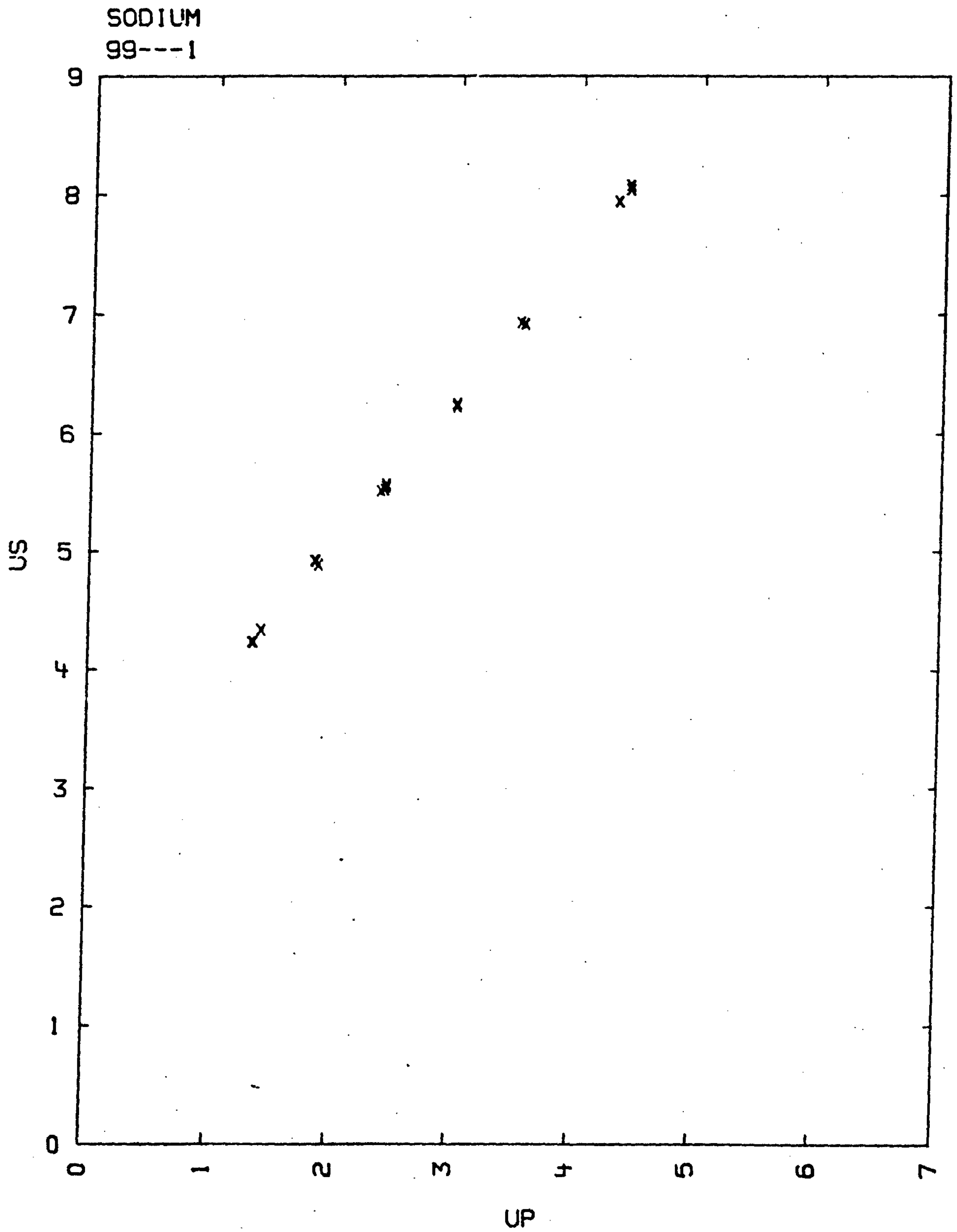
RHOO	US	UP	P	V/VO
0.968	4.336	1.417	59.5	0.6732
-	4.229	1.335	54.7	0.6843
-	4.238	1.347	55.3	0.6822
-	4.918	1.842	87.7	0.6255
-	4.883	1.869	88.3	0.6172
-	4.914	1.849	88.0	0.6237
-	5.521	2.407	128.6	0.5640
-	5.529	2.404	128.7	0.5652
-	5.540	2.419	129.7	0.5634
-	5.505	2.375	126.6	0.5686
-	5.561	2.423	130.4	0.5643
-	6.245	2.998	181.2	0.5199
-	6.225	2.996	180.5	0.5187
-	6.925	3.518	235.8	0.4920
-	6.911	3.547	237.3	0.4868
-	7.942	4.300	330.6	0.4586
-	8.036	4.392	341.6	0.4535
-	8.076	4.392	343.8	0.4562

US = 2.563 + 1.242 UP KM/SEC.

COMMENTS:

1) SOURCE: RICE, M. H.
J. PHYS. CHEM. SOLIDS, VOL. 26, P. 483 (1965)
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 2024 ALUMINUM
3) CO IS CALCULATED BY USING A BULK MODULUS OF 5.92 E+10 DYNES/CM**2.
AMERICAN INSTITUTE OF PHYSICS HANDBOOK, P. 3-81 (MCGRAW-HILL BOOK COMPANY, INC., N.Y., 1957).
4) VOI IS ALSO OBTAINED FROM THE ABOVE REFERENCE

TABLE I



99---2
SODIUM

NA

VO = 1.03 CC/G
VOI = 1.035 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN KM/SEC, AND PRESSURE IN KILOBARS.

TABLE

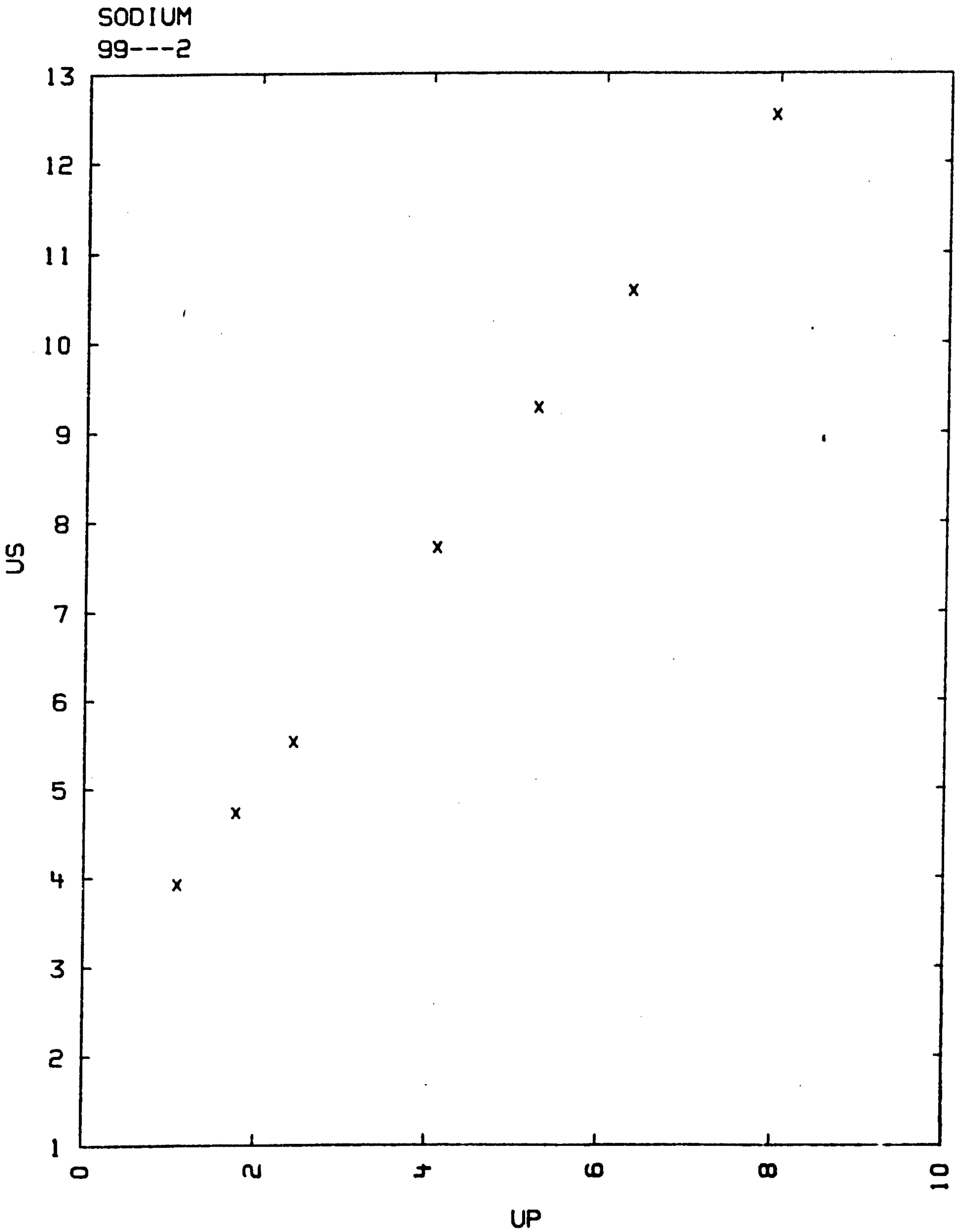
SAMPLE					BASE PLATE	
RHOO	US	UP	P	V/VO	MATERIAL	UP
0.97	3.91	1.10	42	0.719	AL	0.69
-	4.72	1.77	81	0.625	AL	1.14
-	5.53	2.43	132	0.565	AL	1.60
-	7.70	4.09	305	0.467	AL	2.82
-	9.26	5.25	471	0.433	AL	3.70
-	10.57	6.32	648	0.402	PLEXIGLAS	5.85
-	12.52	7.95	966	0.364	PLEXIGLAS	7.38

US = 2.50 + 1.27 UP KM/SEC
SIGMA US = 0.067 KM/SEC

COMMENTS:

1) SOURCE: BAKANOVA, A. A., DUDOLADOV, I. P., TRUNIN, R. F.
FIZIKA TVERDOGO TELA, VOL. 7, NO. 6, PP. 1616 - 1622 (1965).
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) THE FOLLOWING HUGONIOT RALATIONSHIPS FOR THE BASE PLATE WERE USED:
AL STANDARD US = 5.25 + 1.39 UP KM/SEC RHOO = 2.71 G/CC.
PLEXIGLAS US = 3.10 + 1.32 UP KM/SEC RHOO = 1.18 G/CC (FOR US EQUAL OR GREATER THAN 6.0 KM/SEC).
4) OTHER LISTED NA PARAMETERS:
AT 300.0 DEG. K
RHOO 0.97 G/CC
COMPRESSIBILITY 16.3 PER MEGABAR
GRUNEISEN COEF. 1.30
AT 0.0 DEG. K
RHOO 1.013 G/CC
COMPRESSIBILITY 14.3 PER MEGABAR
ELECTRONIC HEAT CAPACITY 596 ERG/G DEG. SQUARE
THE VALUE OF VOI WAS OBTAINED FROM A. TAYLOR AND BRENDA J. KAGLE, CRYSTALLOGRAPHIC DATA ON METAL AND ALLOY STRUCTURES (DOVER PUBLICATIONS, INC., NEW YORK, N. Y., 1963).

TABLE I



100---0
POTASSIUM SUMMARY

K

VO = 1.16 CC/G
VOI= 1.175 CC/G

CO = 1.98 KM/SEC

THE TABLE LISTS THE HUGONIOT POINTS CALCULATED FROM THE FIT GIVEN BELOW.
UNITS ARE: G/CC, KM/SEC, KBAR AND KBAR.CC/G FOR THE ENERGY DIFFERENCE.

TABLE

RHOO	US	UP	P	V/VO	E-EO
.860	3.145	1.	27.0	0.682	5.00
-	4.321	2.	74.3	0.537	20.0
-	5.497	3.	142.	0.454	45.0
-	6.673	4.	230.	0.400	80.0
-	7.849	5.	338.	0.363	125.
-	10.201	7.	614.	0.314	245.
-	12.553	9.	972.	0.283	405.

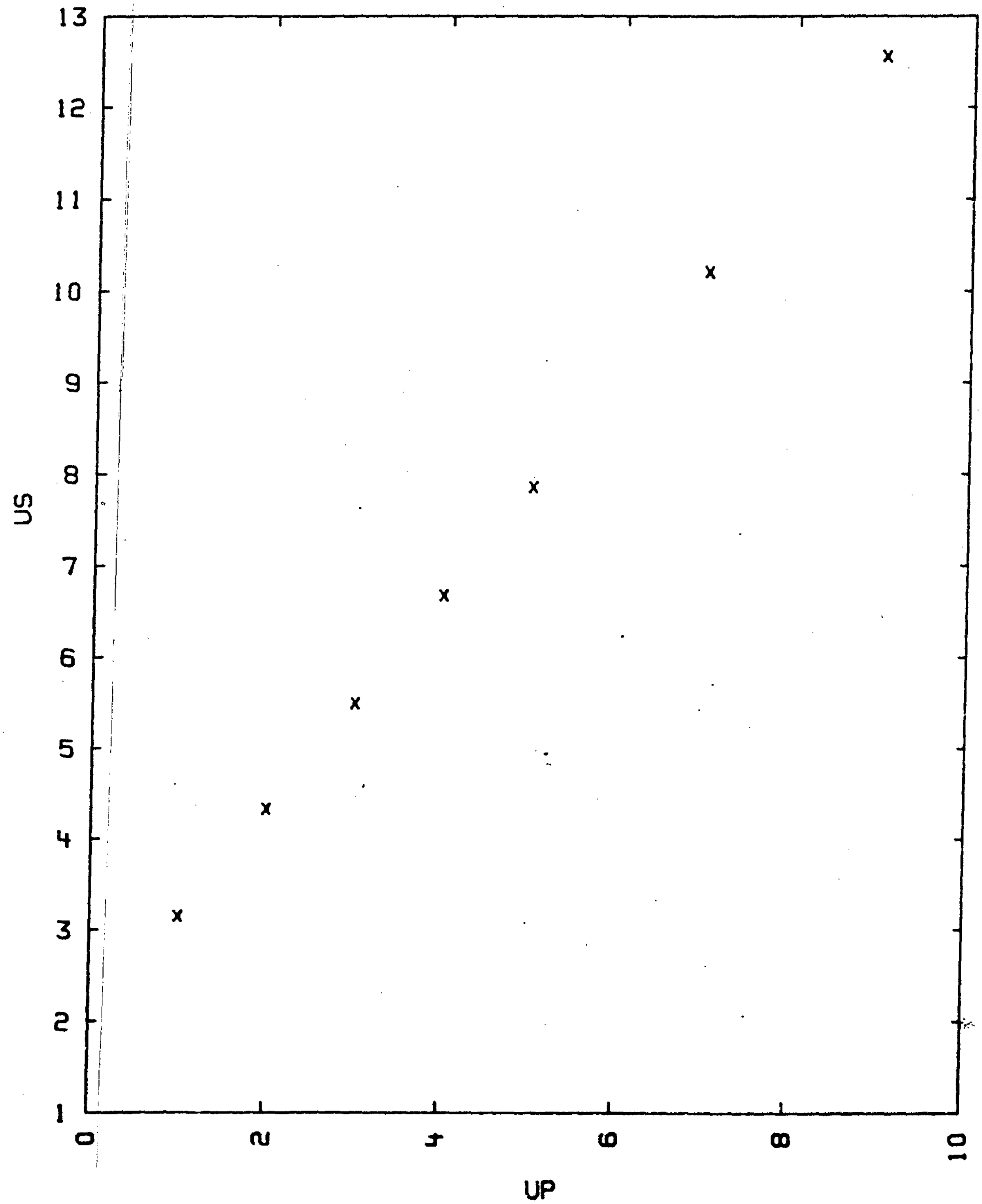
US = 1.969 + 1.176*UP, SIG.US = 0.04 KM/SEC
FOR UP BETWEEN 1.1 AND 8.4 KM/SEC.

COMMENTS

1) SOURCE: COMPILER
1A) THE DATA FROM 100---1 AND 2 WERE USED FOR THIS SUMMARY.
2) ALL POINTS WERE WEIGHTED EQUALLY
3) VOI WAS CALCULATED FROM THE CUBIC LATTICE CONSTANT A = 5.344 ANGSTROM
AM. INST. OF PHYS. HANDBOOK, (MCGRAW-HILL BOOK CO. N. Y., 1963) 2ND. ED.
4) CO WAS OBTAINED FROM THE CUBIC LATTICE CONSTANTS:
C11 = 37.1 KBAR, C12 = 31.5 KBAR, C44 = 18.8 KBAR
P. A. SMITH AND C. S. SMITH, J. PHYS. CHEM. SOLIDS., V. 26, P. 279 (1965)

TABLE I

POTASSIUM SUMMARY
100---0



100---1
POTASSIUM

K

VO = 1.163 CC/G. CO = 2.06 KM/SEC.
VOI = 1.175 CC/G.

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

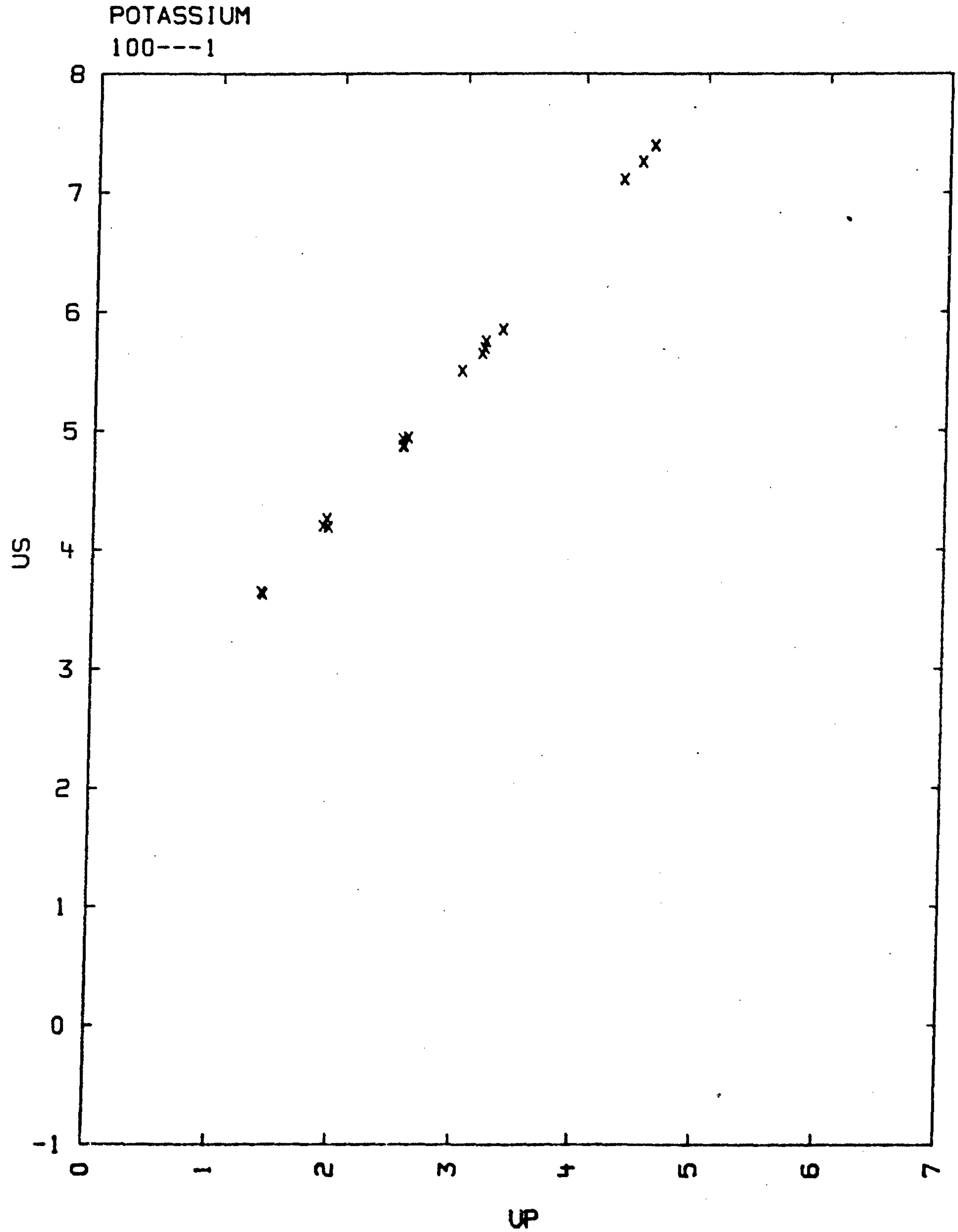
RHOO	US	UP	P	V/VO
0.860	3.641	1.391	43.6	0.6180
-	3.633	1.402	43.8	0.6141
-	4.198	1.882	68.2	0.5500
-	4.187	1.928	69.4	0.5395
-	4.258	1.917	70.2	0.5498
-	4.864	2.513	105.1	0.4833
-	4.874	2.532	106.1	0.4805
-	4.921	2.522	106.7	0.4875
-	4.943	2.561	108.9	0.4819
-	4.949	2.561	109.0	0.4825
-	5.489	2.993	141.3	0.4547
-	5.641	3.149	152.8	0.4418
-	5.683	3.174	155.1	0.4415
-	5.747	3.183	157.3	0.4461
-	5.845	3.318	166.8	0.4323
-	7.108	4.324	264.3	0.3917
-	7.258	4.468	278.9	0.3844
-	7.392	4.573	290.7	0.3814

US = 1.930 + 1.188 UP, SIG.US = 0.039 KM/SEC.

COMMENTS;

1) SOURCE: RICE, M. H.
J. PHYS. CHEM. SOLIDS, VOL. 26, P. 483 (1965)
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 2024 ALUMINUM
3) CO IS A CALCULATED VALUE OBTAINED BY USING A BULK MODULUS OF 3.61 E 11 DYNE/CM**2.
AMERICAN INSTITUTE OF PHYSICS HANDBOOK, P. 3-81 (MCGRAW-HILL BOOK COMPANY, INC., N.Y., 1957).
4) VOI IS CALCULATED USING A LATTICE CONSTANT OF 5.344 ANGSTROMS.
AMERICAN INSTITUTE OF PHYSICS HANDBOOK, (MCGRAW-HILL BOOK COMPANY, INC., NEW YORK, 1963) 2ND ED.

TABLE I



100---2
POTASSIUM

K

VO = 1.16
VOI = 1.099 CC/G

IN THE TABLE BELOW, DENSITY IS GIVEN IN G/CC, VELOCITIES IN KM/SEC. AND PRESSURE IN KILOBARS

TABLE

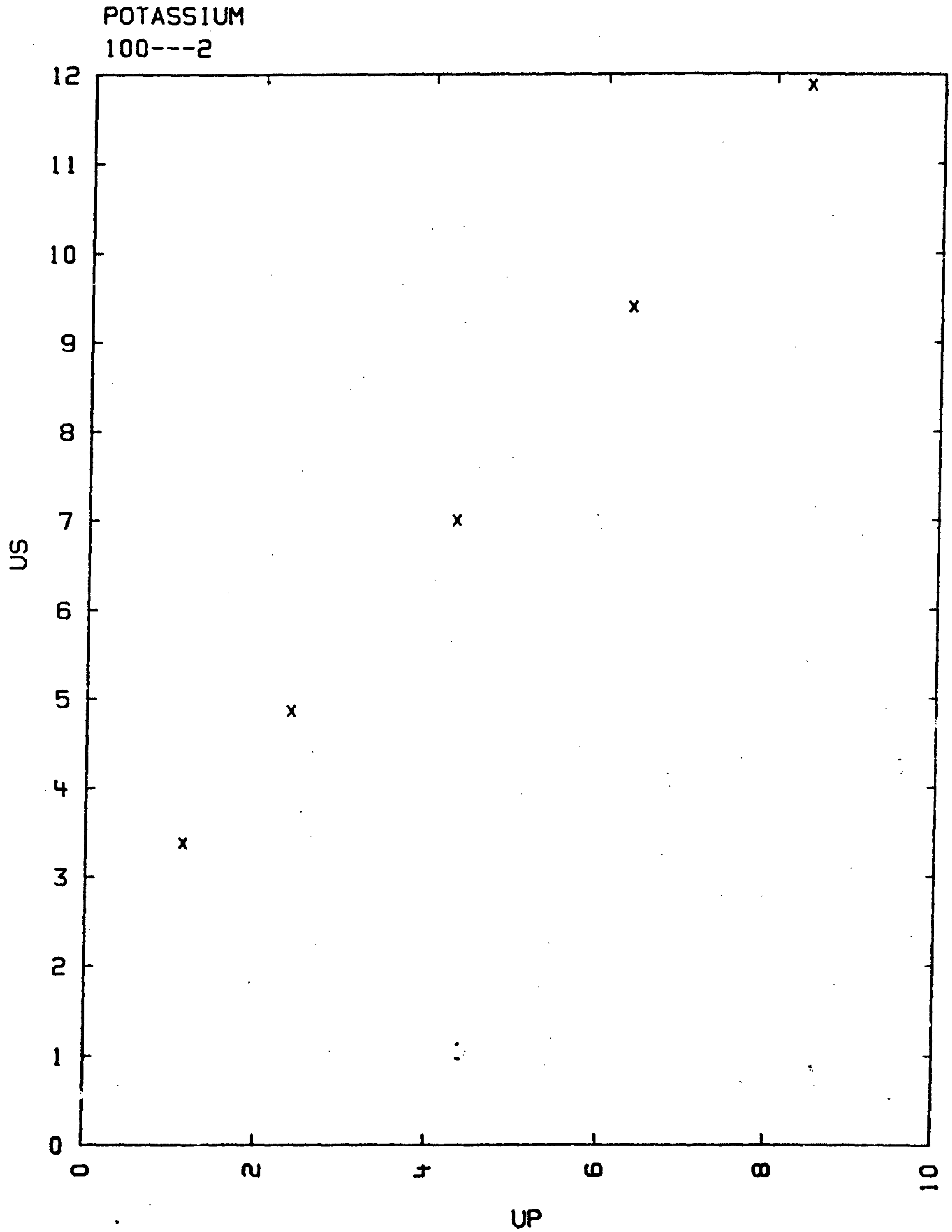
SAMPLE					BASE PLATE	
RHOO	US	UP	P	V/VO	MATERIAL	UP
0.86	3.37	1.15	33	0.658	AL	0.69
-	4.86	2.38	100	0.510	AL	1.50
-	6.99	4.29	257	0.385	AL	2.82
-	9.39	6.32	510	0.327	PLEXIGLAS	6.51
-	11.87	8.41	860	0.292	PLEXIGLAS	7.38

US = 2.04 + 1.17 UP KM/SEC
SIGMA US = 0.044 KM/SEC

COMMENTS:

1) SOURCE: BAKANOVA, A. A., DUDOLADOV, I. P., TRUNIN, R. F.
FIZIKA TVERDOGO TELA, VOL. 7, NO. 6, PP. 1616 - 1622 (1965)
2) EXPERIMENTAL TECHNIQUE A.
DATA REDUCTION TECHNIQUE B.
3) THE FOLLOWING HUGONIOT RALATIONSHIPS FOR THE BASE PLATE WERE USED:
AL STANDARD US = 5.25 + 1.39 UP KM/SEC RHOO = 2.71 G/CC
PLEXIGLAS US = 3.10 + 1.32 UP KM/SEC RHOO = 1.18 G/CC (FOR US EQUAL OR GREATER THAN 6.0 KM/SEC).
4) OTHER PARAMETERS LISTED FOR K WERE:
AT 300.0 DEG. K
RHOO 0.86 G/CC
COMPRESSIBILITY 35.6 PER MEGABAR
GRUNEISEN COEF. 1.30
AT 0.0 DEG. K
RHOO 0.909 G/CC
COMPRESSIBILITY 18.5 PER MEGABAR
ELECTRONIC HEAT CAPACITY 560 ERG/G DEG. SQUARE

TABLE I



101---1
RUBIDIUM

RB

VO = 0.6536 CC/G CO = 1.13 KM/SEC.
VOI = 0.6536 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

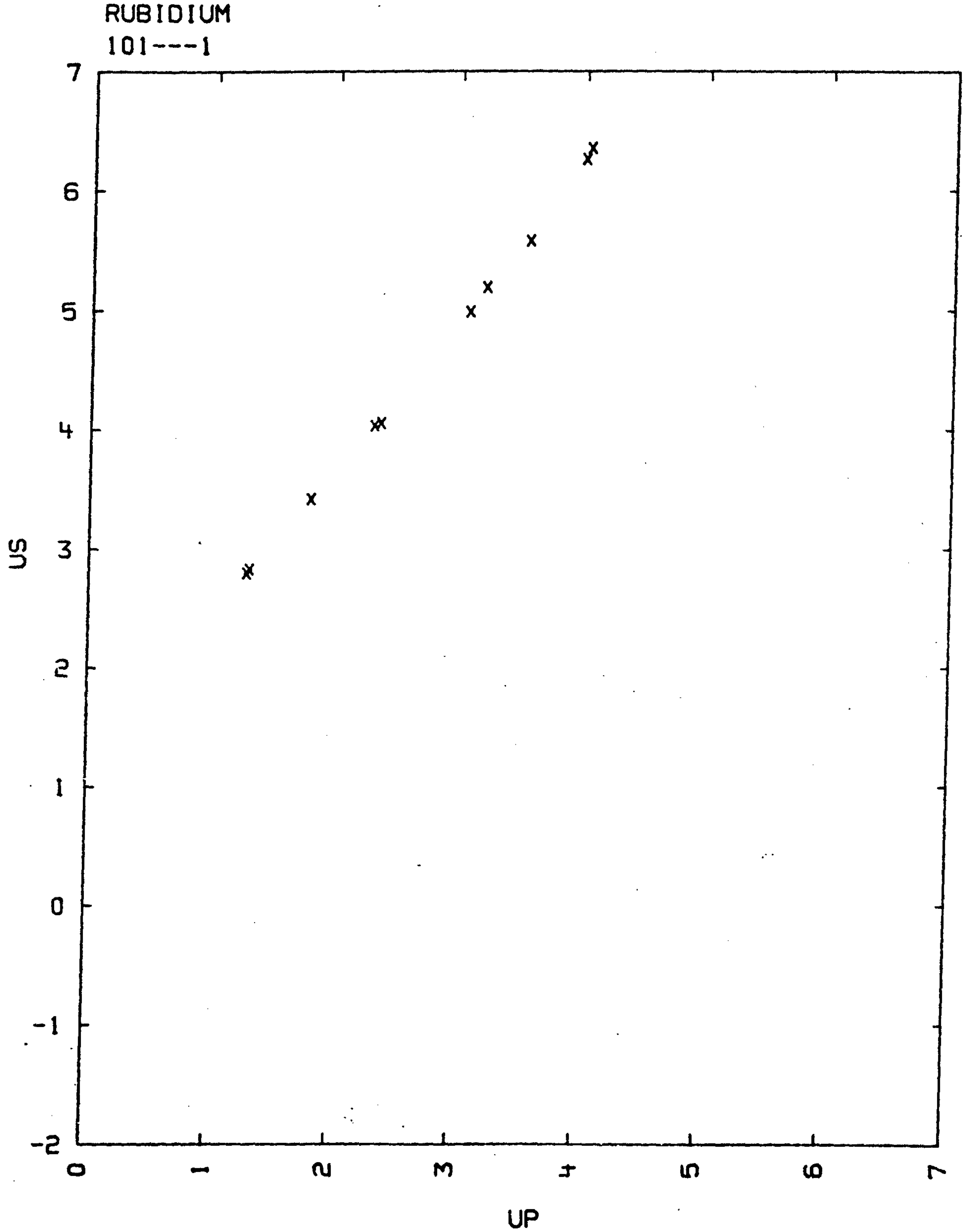
RHOO	US	UP	P	V/VO
1.530	2.786	1.289	54.9	0.5373
-	2.820	1.312	56.6	0.5348
-	3.412	1.814	94.7	0.4683
-	4.032	2.320	143.3	0.4253
-	4.050	2.373	147.0	0.4141
-	4.988	3.085	235.4	0.3815
-	5.187	3.220	255.5	0.3792
-	5.574	3.563	303.9	0.3608
-	6.256	4.001	383.0	0.3604
-	6.349	4.043	392.7	0.3632

US = 1.184 + 1.232 UP, SIG US = 0.030 KM/SEC.

COMMENTS:

1) SOURCE: RICE, M. H.
J. PHYS. CHEM. SOLIDS, VOL. 26, P. 483, (1965)
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 2024 ALUMINUM
3) CO IS CALCULATED BY USING A BULK MODULUS OF 1.962 E 10 DYNE/CM**2.
C. KITTEL, INTRODUCTION TO SOLID STATE PHYSICS,
(JOHN WILEY AND SONS, INC., NEW YORK, 1956) 2ND ED.

TABLE I



102---1
CESIUM

CS

VO = 0.5476 CC/G   CO = 0.87 KM/SEC
VOI = 0.5219 CC/G

IN THE TABLE BELOW, VELOCITIES ARE GIVEN IN MM/MICROSEC., PRESSURE IN KILOBARS AND DENSITY IN G/CC.

TABLE

RHOO	US	UP	P	V/VO
1.826	2.489	1.402	63.7	0.4367
-	2.493	1.395	63.5	0.4404
-	2.994	1.758	96.1	0.4128
-	2.998	1.770	96.9	0.4098
-	3.695	2.239	151.1	0.3940
-	3.719	2.268	154.0	0.3902
-	4.953	3.202	289.6	0.3535
-	5.822	3.894	403.6	0.3312
-	5.847	3.919	418.4	0.3297

US = 0.34 + 1.600*UP + 0.050*UP**2 KM/SEC, SIG.US=0.013 KM/SEC

COMMENTS:

1) SOURCE: RICE, M. H.
J. PHYS. CHEM. SOLIDS, VOL. 26, P. 483, (1965)
2) EXPERIMENTAL TECHNIQUE B
DATA REDUCTION TECHNIQUE B
STANDARD MATERIAL 2024 ALUMINUM.
3) CO IS CALCULAED BY USING A BULK MODULUS OF 1.457 E 10 DYNE/CM**2.
C. KITTEL, INTRODUCTION TO SOLID STATE PHYSICS, 2D ED.,
JOHN WILEY AND SONS, INC., NEW YORK, 1957.
4) VOI IS CALCULATED USING THE LATTICE CONSTANT OF 6.13 ANGSTROMS.
W. P. PEARSON, INTERNATIONAL SERIES OF MONOGRAPHS ON METAL PHYSICS
AND PHYSICAL METALLURGY, (PERGAMON PRESS, NEW YORK, 1958).

TABLE I